CHEMICAL & METALLURGICAL ENGINEERING

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CONTENTS FOR SEPTEMBER, 1939

FACTS AND FIGURES OF AMERICAN CHEMICAL INDUSTRY

(See also detailed Table of Contents, page 540)

Cover picture shows a lime slaker in the alkali plant of the Mathieson Alkali Works at Lake Charles, La. In the background are milk of lime tanks and the lime kiln building. *(Cover space released for editorial use by the Patterson Foundry & Machine Co.)*

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S. D. KIRKPATRICK, *Editor*

Let's Look at the Record!

Many see in the war-ridden world of today a striking similarity with conditions of twenty-five years ago. The storm of destruction that broke loose in Europe in 1914 now finds its deadly parallel in Germany's invasion of Poland. But there is one very essential difference in the situation, both there and here, which is of vital significance to all in chemical industry. Chemical preparedness in this country—in fact in most of the major countries—is an immediate reality that creates a vastly different problem than that of 1914.

A timely record of what chemical industry has been accomplishing here is presented in the 1939–1940 edition of "Facts and Figures of American Chemical Industry," which features this issue of *Chem. & Met.* It is a story of a war-born industry that has had its great growth and development because it has contributed even more to our peace-time progress. Through its research and technology it has made us more nearly self-sufficient than any other nation. Through its stimulating influence, it has given strength and resourcefulness to our whole industrial system. All of this is an invaluable asset to Uncle Sam—whether he can avoid the conflagration or eventually is forced to take a hand in putting out the fire.

Chemical industry is now entering a very critical period in which it must be prepared to meet many unusual demands. There will always be a few to contend that nationalization of basic industries is an inevitable consequence of a national emergency. Yet there is nothing that could be more fatal in a field that depends upon a creative, aggressive and efficient management. There will come the demands for speeded production, for allocation of raw materials, and perhaps some public control of production facilities. Here there must be full cooperation of industry and government but making certain that the functions of private enterprise are fully preserved.

The new War Resources Board will now have its really great opportunity. Those who recall the masterly handling of the almost insoluble problems of 1917 by Bernard M. Baruch, will expect equally fine results from E. R. Stettinius, Jr. and his able associates. Fortunately they have the advantage of starting without the terrific pressure and feverish activity generated by America's actual participation in war. If they can eliminate the chaos that characterized Washington in those early days, they will have rendered a great patriotic service.

Perhaps the most immediate benefit can come from a willingness on the part of chemical industry to refrain from rushing to Washington to clamor for special attention. As yet no chemical representative has been named to the War Resources Board, but that defect will doubtless be corrected as the need becomes sufficiently urgent. In the meantime, the Chemical Alliance, Inc., and the Manufacturing Chemists Association are effective agencies to assist in studying the problems of material supplies, employment, transportation and marketing. If such studies are kept on the broad plane of the general service which can be had from the industry as a whole, there can be no criticism of selfish interest and petty demands based on competitive advantages.

The problems of either peace or war are too vital to be settled on the basis of anything other than accurate knowledge of all the facts. That would seem to make it all the more important that those of us in chemical industry not only become more familiar with its basic statistics but make certain that that knowledge is spread in all directions in which it can help to create a better understanding of our objectives and accomplishments. "Facts and Figures of American Chemical Industry" presents a record of which we can be justly proud. Let's use it often in these troubled times!

From an

FACT FINDING FOR PROGRESS

CHEMICAL INDUSTRY proceeds on the philosophy that facts must be faced. Science and engineering owe much of their advance to the correlation and use of factual knowledge of natural phenomena. Comparable information on economic and social trends, although not so readily available, is equally important. For this reason *Chem. & Met.* has again attempted to bring together in this issue the "Facts and Figures of American Chemical Industry."

Our presentation of this material would be incomplete without an acknowledgment of the great assistance which had been given to us both by government men and those in industry. We are particularly indebted to Warren N. Watson, the executive secretary, and his assistant, Maurice F. Crass, Jr., of the Manufacturing Chemists' Association. Without the sincere and complete cooperation of that organization, many of the figures which give intimate information of chemical industry could not have been made available. It is hoped that the result will prove a constructive influence in the further advance of the industry. If it serves that purpose, *Chem. & Met.* will be amply repaid for the cost and hard work that have gone into its preparation.

SPEEDING PATENT ACTIONS

FIVE CHANGES in the patent laws were made by Congress and approved by the President at the end of the last session. All of these will speed up patent procedure. Some of them also restrict very importantly the privileges of the inventor or patent licensee.

To some extent these acts satisfy the desire of the anti-monopoly group of Congress. But it is important to note that this group did not succeed in passing either of the other two bills which it desired. These bills which failed would have established a single court for patent appeals, and would have limited the life of a patent to 20 years from the date of filing. Thus, two bills continue in Congress for further consideration next year.

The five measures which passed make restrictions on the time or the scope of patent actions. An inventor must now file application for a patent within one year of public use (formerly it was two years). Interference practice is greatly simplified. Renewal applications are abolished. Responses to Patent Office actions may be required in less than six months, the former statutory limit. Copying of claims from issued patents to secure interference must now be done within one year (formerly two years were allowed).

The enactment of these five measures will importantly influence the way that research men and patent departments of companies must conduct their business. It is evident that Congress was in a mood somewhat to restrict the privileges of getting a patent. But fortunately the mood did not extend to any serious breakdown of the patent system.

Companies must now be more on the alert in their patent efforts. Next year they can expect to meet even more stringent and restrictive proposals in Congress. Those thus far enacted are not serious, but should be carefully studied so that patent rights do not lapse through neglect.

PROTECTION AGAINST EFFICIENCY?

CHEMICAL INDUSTRY is facing the prospect of higher costs of transporting its raw materials and finished products. That fact can no longer be ignored even though it is not at all certain that anything can be done about it.

The avowed purpose of those who advocate a coordinated system of federal control of all transportation is to secure protection for the railways, allegedly against destructive competition from other forms of transportation. In the Motor Carrier Act of 1935 they succeeded in putting highway transprotation under the jurisdiction of the Interstate Commerce Commission. Already the effect is being seen in higher costs and increasing regimentation extended even to trucks privately owned by industry. Now if the Wheeler-Truman Bill which passed the Senate and the Lea Bill which passed the House are reconciled and made into law by the next Congress, the same stupefying federal regulation will be imposed on the waterways. Thus will be removed

Editorial Viewpoint

almost the last threat against the inefficiencies and ineffectiveness of our present transportation system.

In many areas the waterways offer a competitive system at much lower costs than either rail or highway. They therefore hold back the multiplication of technicalities and the bureaucratic nuisances that burden the other transportation agencies. Even those who sympathize with the railways admit this privately, but they deny it in a most sanctimonious manner before Congressional committees. There they explain that the railways must be protected because they are the "backbone of the American transportation system." Granted that they are, one nevertheless wonders if they are not being protected against the progress and efficiency that characterize private enterprise. Chemical industry should do all in its power to resist these uneconomic efforts to raise all transportation costs in order to force business back onto the railroad. It's time to declare war on such bureaucracy.

MORE PETROLEUM REGULATION?

SECRETARY ICKES is not satisfied with the authority which his Department has in the regulation of the petroleum industry. It is proposed that a new regulatory administration be established under the title "Office of Petroleum Conservation."

The wastes and the problems of the petroleum industry are unquestioned. They may need further and official attention. The industry itself is helpless on some points. But there is some question about the selection of "Honest Harold" in the self-appointed role of dictator of the industry's future. Too many recall the harrowing experiences of Harold's administration during NRA days.

If the industry can formulate a regulatory program that will really solve the fundamental problems, it should do so. Such solutions should not be half-hearted, inadequate opportunism. A drastic plan is needed. Unless the industry will formulate, and does present, forcefully and in good faith, such a program, Congress will have but little chance of escaping the placing of this industry under the Department of Interior for more regimentation. It is up to the industry to act in its own interest.

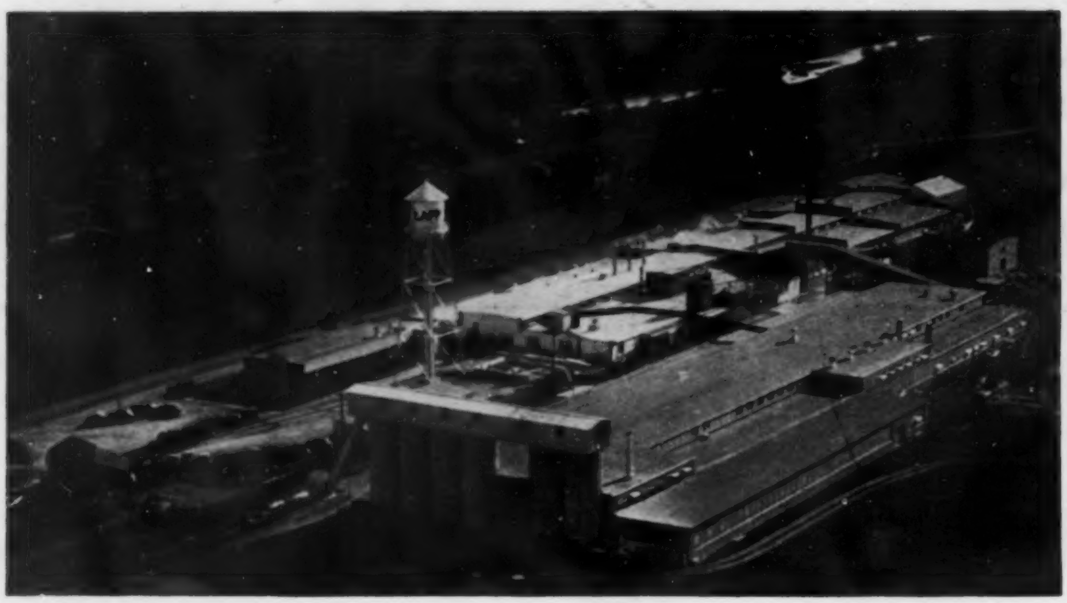
PLASTICS GO PEDAGOGICAL

PHENOMENAL GROWTH in interest in the field of plastics continues unabated. Among recent manifestations are announcements from two educational institutions of special courses of instruction in the subject. The Division of University Extension of the Massachusetts Department of Education is offering a course in the industrial chemistry of plastics to be given at the Massachusetts Institute of Technology commencing in November. Professors Warren K. Lewis and Charles E. Reed of the Institute's department of chemical engineering have been appointed as instructors. The other course of study is being sponsored by the Graduate School of the U. S. Department of Agriculture at Washington. Dr. Lee T. Smith will have charge of the instruction. These courses are open to anyone interested, but will be particularly valuable to those engaged in the production of plastics and to those in other industries in which plastics may become important factors in the future.

CARBIDE'S BAKELITE

VERTICAL INTEGRATION continues apace in the rapidly growing field of plastics. With the acquisition on August 29 of all the assets of the Bakelite Corporation, Union Carbide & Carbon Corporation becomes the third big factor in the integrated production of plastics. Like duPont and Monsanto, Carbide is now in a position to see its own basic chemical raw materials processed by Bakelite into a variety of plastic compositions. The pioneering organization built up by the great zeal and ability of Dr. Leo H. Baekeland, is now assured of an even more promising future as a Carbide subsidiary, along with Linde, Electro-Met, National Carbon, Chemicals and the others.

This union of chemical and plastic producers is in keeping with the trend noted in these columns last February when in an editorial entitled "Whither Plastics?", we pointed to some of the advantages to be gained by more complete processing of chemical raw materials for use as plastics. Our conclusion then and now is that plastics is becoming more than ever a chemical manufacturing industry.



New Ceramic for Plant Equipment

How the Lapp Insulator Co. has applied its long experience in making electrical porcelain to the production of a new line of chemical plant equipment constructed of a similar strong and resistant material is told in words and pictures in this "plant visit."

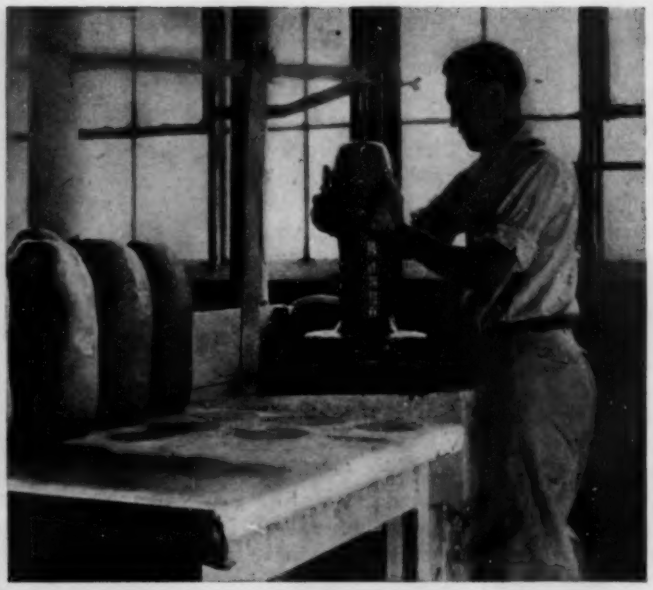
THEODORE R. OLIVE
Associate Editor
Chemical & Metallurgical Engineering

WITH over 20 years' experience in making high grade porcelain insulators by techniques largely new to the ceramic industry, the Lapp Insulator Co., LeRoy, N. Y., decided in 1938 to supplement its manufactures with a line of plant-scale chemical porcelainware. Less than a year's work with the new ware solved the principal production problems and a large number of items such as pipe, fittings, valves, jars, kettles, pots and filters have now been on the market for several months. Although insulator technique proved translatable almost directly into the means for producing the smaller articles of chemical ware, there was no previous experience with this type of porcelain body used for extremely large pieces, and it has been necessary to design and build considerable special machinery.

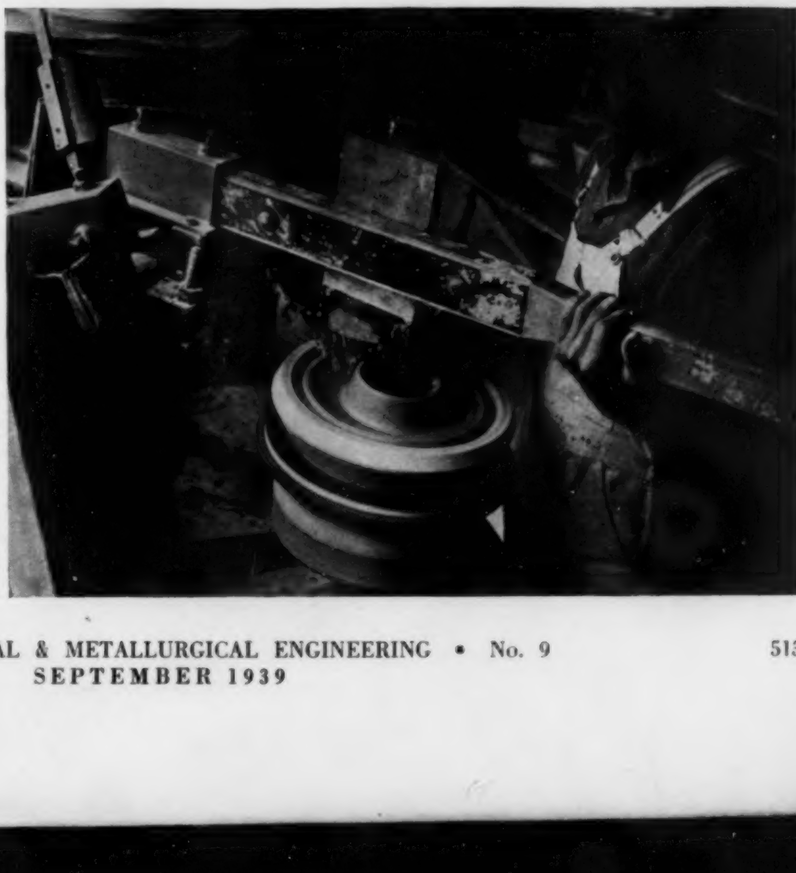
In fact, the entire Lapp plant is filled with special machinery. Little of it is standard. Some has been purchased and modified according to the ideas of the company's chief engineer, while even more of it has been developed, designed and constructed in the plant without outside assistance. Unhampered by ceramic traditions, the company has adapted many excellent ideas from other industries and the resulting machinery appears to be of unusual efficiency.

The story of this new product and how it is made naturally starts with the porcelain body. Service of insulators requires, among other things, a body of extremely high mechanical strength and zero absorption. During the early days of the Lapp company and several years before the present general interest in the de-airing of ceramic clays, it was recognized by the Lapp management that the romoval of all air bubbles from the clay, as well as the bulk of the air dissolved in the admixed water, was a vital concern in attaining these characteristics. Hence an efficient slip de-airing process was developed and has been in constant use since 1922. This permitted the production of a plastic clay for forming which was without voids. Ware fired from such clay consequently contained only sub-microscopic, non-communicating pores. A dye penetration test developed for control purposes, in which the attempt is made to force dye into the pores of the unglazed ware under pressures ranging upwards to 100,000 lb. per sq. in., is used regularly to show that zero dye absorption is maintained. About 2 per cent greater density is achieved with this process than without de-airing and the other well-known advantages of vacuumized clay are also secured.

In addition to its high density, the body is unaffected by acids (except hydrofluoric) and is resistant to alkalis. Its elasticity is about three times



Left—Lapp Insulator Co. plant from the air. Left Above—Air bubbles removed from the slip in the vacuum tank escape from the ejector circulating water. Right Above—Potter throwing a clay blank for a cylindrical article to be finished on the lathe. Right—This modified pug mill plasticizes the clay before throwing, jiggering or plunging. Below—Jiggering is used for the formation of most hollow ware other than pipes and tubes



that of steel, its compressive strength of the order of 100,000 lb. per sq. in. and its tensile strength 5,000-8,000 lb. per sq. in. Thermal conductivity is rated at 8.4 B.t.u. per sq. ft., degree F., hour and inch of thickness.

Except for a few special bodies for smaller lots of non-standard chemical ware (which are produced in a special mixer and special vacuum pug mill), clay for objects of the chemical line goes through much the same steps and operations as that for insulators. The four raw materials, English ball and china clay, Pennsylvania flint and Canadian feldspar are all purchased under rigid specifications of composition, screen analysis and quality. Received in freight cars on the company's siding, the materials are unloaded to a bucket conveyor and elevated to six concrete silos, each holding six carloads. From the silos, materials are weighed into weigh hoppers and dropped in the desired proportions into an underground screw

conveyor which carries the mixture to the raw mix blungers, meanwhile effecting a preliminary mixing. Ball clay, which is stored out of doors, is first shoveled into an ice-breaker which picks it to bits, then drops it into an underground agitated cistern or blunger where it is mixed with the total amount of water subsequently required for mixture with the other materials. Removal of traces of organic matter from the ball clay is accomplished by pumping the suspension over a vibrating screen or lawn. The purified suspension is then pumped to a second underground blunger where the china clay, flint and feldspar are added. Material is removed from this blunger over a second lawn and pumped to pebble mills for several hours' milling. Lawned a third time, the suspension then flows to a stock cistern ready for the first de-airing stage.

Since the proper pH is important in this process, routine pH tests are conducted with the glass electrode and adjustments of the slip pH made if necessary. Unsuitable hydrogen ion concentration sometimes follows seasonal disturbances of the water supply and a small correction is ordinarily needed to compensate for slight changes in the clays.

The patented Lapp de-airing process removes the air from a thin slip or suspension of the clay rather than from plastic clay as in other processes, for which reason it is claimed to do a much more thorough job. In the first de-airing the clay slip is pumped to a vacuum tank elevated high enough above the working floor so that the suspension can leave the tank by gravity. Here it is subjected to vacuum produced by a water jet ejector supplied with water recirculated by a centrifugal pump. Under low pressure the water of the suspension boils vigorously, lowering the slip temperature several degrees. The boiling assists materially in removing the last traces of air. A condenser coil between the boiling slip and the vacuum connection condenses most of the water boiled off and returns it to the slip, allowing the air to pass on to the ejector. The slip then descends by gravity to a second stock cistern from which it is withdrawn after a waiting period to a second vacuum tank similar to the first, but on a lower level and provided with two ejectors. A period of detention between the two evacuations has been found to yield better results. Pumped from the second cistern the now thoroughly de-aired slip is held ready for pumping to the filter presses.

Top—Slip casting in plaster molds such as these is used for the formation of intricate parts

Above—Green clay articles ready for firing in the kiln are set in saggers on kiln cars

Level is controlled in the vacuum tanks by an ingenious arrangement which will be described in detail at another time. The entire tank is counterbalanced and its movement opens and closes an inlet, or outlet, valve, as the case may be, so as to maintain a constant level of slip in the tank.

From the final stock cistern the slip is withdrawn by plunger pumps and forced into a group of filter presses. Variable pressure control on the press feed line, which is necessary to assure the proper moisture content of the filter cake, is accomplished in a simple and novel manner. The pump relief valve returns any slip in excess of that passing to the presses to the supply cistern. The relief value is of the weighted lever type, the weight consisting of a water container into which water runs slowly during the press filling so as to give the desired time-pressure curve on the presses. That this curve is actually achieved during each press cycle is shown by a pressure recorder on the press feed line.

When the presses have been filled to the desired density, with cakes containing approximately 20 per cent of water on the dry basis, they are opened and the cakes removed. Weekly steaming of the presses prevents sliming of the cloths and makes them last indefinitely. Cakes are stacked on trucks and stored under canvas to prevent loss of moisture while the clay is awaiting the pugging operation. The effectiveness of this preparation eliminates the need for "aging" of the clay.

Top—For turning the clay blank the operator uses a Carboloy tool and a metal template

Above—Here the lathe tool supports, lathes, dust collecting system, clay blanks and turned clay ware are clearly shown

Some of the more intricate shapes in both the insulator and the chemical-ware lines, particularly thin-walled articles, are produced by the slip casting process. The slip for this purpose is prepared and de-aired similarly to the method just described, except that filter pressing is omitted and a suitable addition of electrolytes is made. The slip casting department has an extensive mold shop where plaster-of-paris casting molds, as well as the jigger and plunger molds for insulators and chemical ware, are made. In this department the closed molds are arranged on benches and filled with a slip having the consistency of thick cream. Water immediately is absorbed by the plaster mold and clay deposits on its walls. After the clay has built up to a sufficient thickness—usually in about one-half hour—the remaining slip is poured out, or the core mold is drawn, and the mold permitted to dry enough to allow removal of the clay object for final drying prior to the needed finishing operations, and firing.

More used than slip casting, however, are the plastic clay forming processes. First the press cakes of clay must undergo a thorough plasticizing and homogenizing in a pug mill which has been modified from standard by the use of special knives to avoid the inclusion of air. Another modification is the use of an auxiliary mixer between the auger and the die, designed to eliminate completely any laminations in the clay produced in the auger. The clay is extruded as a continuous column of suitable diameter which is cut to proper length for a particular object and stacked on trucks for conveying to the appropriate forming operation. Chemical-ware pipe, however, as well as other hollow cylindrical shapes such as tower packing rings, are extruded directly from a cored die of the desired inner and outer diameter, cut to length as the tube issues from the pug mill, and then given any necessary finishing operations, followed by drying and firing.

Several forming methods are employed. Bulky cylindrical shapes such as those required for long insulators are first prepared as blanks by throwing on a potter's wheel. The blanks, after drying, are mounted on the spindle of a lathe and turned to finished shape using a Carboloy tool. The lathe bench is a particularly good example of this company's genius for design. Grouped either side of a dust and waste clay collecting system are lines of lathes consisting of individually motor-driven cantilever spindles supported on preloaded Timken bearings. The cutting tool is mounted on a long rod supported overhead by a ball joint. A metal template fastened to a shelf above the lathe is used to direct a guide finger attached to the rod. With the template contour cut to the finished dimensions, this arrangement so guides the tool as to cut the blank oversize by an amount just sufficient to allow for the shrinkage in firing. A specially compounded abrasion-resisting rubber deflector attached to the tool diverts the cuttings into a hopper, while an indraft of air into the collector pulls all cutting dust away from the workman and into the dust system. In the bottom of the hopper, and serving both lines of lathes, is a Redler conveyor which takes the cuttings to elevated bins from which they are returned in dust-tight carts to the primary blungers for re-processing. Through the use of de-aired clay which requires no aging, no disadvantage exists in the re-use of these cuttings.

Equal care to avoid suspension of clay dust in the air is evident at every point in the plant where dust may originate. So efficient is the lathe dust collecting system, for example, that dust counts at the breathing level are as low as they are anywhere in the plant.

A pressing operation known as plunging is used to form certain relatively flat shapes. Here a disk of clay is pressed into a steel reinforced plaster mold by the use of a steel die. A more commonly used method is jig-

gering in which the clay is compacted inside a plaster mold, rotated on a potter's wheel, by means of a profile, the outline of which determines the inner contour of the piece. This is the principal method used in forming hollow ware other than pipe. A recently completed jigger having a rotating platform some 4 ft. in diameter is used for large pots and kettles up to 75 gal. capacity. Another machine now in construction will handle vessels upwards of 150 gal. capacity as the technique is acquired to produce larger process equipment.

The foregoing has covered the principal forming methods. Others used include abrasive cut-off saws for both the dried and the fired ware, and a variety of special precision machines for drilling holes, reaming, routing out, shaping, surface grinding and other operations. Most of these machines were developed at the plant and show a high degree of accuracy and efficiency, suggestive more of the metal working machinery which often influenced their design than the usual sorts of ceramic machinery.

Novel Dryer Used

Ware is dried prior to firing in various way, depending on the size of the piece. Some pieces are dried on racks or otherwise supported in the workroom, while the more critical pieces are passed through a large tunnel dryer of unique design. This dryer, designed and built at the plant, is of sheet metal on 2x4-in. wooden studs, heavily insulated with rock wool. A large volume of air circulation is maintained crosswise of the dryer by V-belt-driven disk fans which exhaust the air at one side, pass it back over steam coils in the space above the drying chamber, and return it to the drying space at the far side. An interesting feature is the means used to reduce the air resistance at the bends. At either side of the dryer numerous light-gage metal ells are placed horizontally in a manner similar to the vanes often placed along the diagonal of square elbows in large air conditioning ducts. Power for the fans is thus kept to an exceptionally low figure. Humidity control in the dryer is accomplished by regulation of the fresh air intake. Drying trucks are pushed through the dryer automatically, provision having been made for regulating the through time for each track independently, to accommodate different kinds of ware.

Mention at this point should be made of the general layout of the plant. In the older No. 1 plant most of the slip is prepared, filtered and pugged. Blanks for the lathes are largely thrown in the newer No. 2 plant (built in 1924) where they are dried in the dryer just described. Likewise in No. 2 are the jiggers, and the ware formed by this method is dried at this point also. Ware to be machined in the dried state is then returned to No. 1 plant, either by a long loop carrier conveyor which joins the two plants, or by electric hydraulic lift trucks and skids. Finished green ware is loaded in No. 1 plant into saggers carried by the aforementioned conveyor, then transported to plant No. 2 where the conveyor turns and carries the ware the length of the kiln storage track for transfer to the waiting kiln cars. In No. 2 plant is the 382-ft. Harrop natural-gas-fired kiln which is arranged for waste heat recovery for building heating in the winter time. Also in this plant are the raw material silos, the tunnel dryer, the casting and plaster mold departments, a sagger press for sagger preparation, most of the jiggers and potter's wheels, the glazing department, and a duplicate set of slip preparation equipment.

Before firing the ware, glaze is applied by dipping or spraying and sanding is also applied to roughen any surfaces to which attachments are later to be made by cement or metal.

The tunnel kiln, which replaced several periodic kilns formerly used, is one of the largest in any ceramic plant. One novel feature is the automatic timer that has been devised for controlling the speed of operation of the hydraulic pusher. This device, which is adjustable for several speeds, uses a synchronous clock motor to drive one side of a small differential gear. The other side is driven from the pusher itself. Any tendency toward rotation of the differential, indicating incorrect speed for the pusher, changes the opening of a valve in the oil line to the pusher and instantly adjusts the flow to maintain correct speed.

How Ware Is Fired

Although numerous thermocouples are located along the length of the kiln, their use is supplemented by frequent optical pyrometer readings. A simple indicator used by the operator shows the location of every car in the kiln so that the instantaneous position of any car bearing special materials may be checked at any time. By means of adjustment to one or more of the large number of burners located in the firing section it is thus possible, within limits, to control individually the heat supplied to certain of the cars which may require a "custom" burn. A normal firing temperature for chemical ware is in excess of 2,300 deg. F., with a retention in the kiln in the neighborhood of four days. After firing, the cars are withdrawn from the kiln by a transfer car and run on to the storage track where the final cooling of their contents takes place.

After cooling the cars are unloaded to the loop conveyor which returns the fired ware to the inspection, testing, finishing and packing departments in plant No. 1. In these departments joints are ground and polished if necessary; metal parts are cemented into place if required; and hydrostatic, electrical or other tests are made to insure acceptability of the ware.

Thus this hasty tour of the plant is completed. Grateful acknowledgment is due to the Lapp management for guidance and assistance, particularly to Messrs. John S. Lapp, president, Grover W. Lapp, secretary and chief engineer, and Brent Mills, sales manager.

Shipment of chemical porcelainware nozzles ready for packing

How to Dry Efficiently

So many types of dryer are now available that practically any drying problem can be handled efficiently with standard or only slightly modified equipment. Mr. Lissauer outlines the principal types and compares their efficiencies and fields of usefulness.

A. W. LISSAUER
President, Louisville Drying Machinery Co., Louisville, Ky.

There are many different types of drying machine, most of which have in common only the ability to remove water more or less economically from some certain class of material. Since such equipment is generally peculiarly adapted to the handling of materials of specific characteristics, the achievement of efficiency in drying demands study to insure that only the most suitable type is employed in any given case. For convenience in presenting this outline, and with the understanding that it is but a rough classification, the writer would like to divide all materials to be dried into three major classes.

The first class includes liquids and slurries, i.e., those materials which can flow and which contain solids in solution and/or suspension. The second covers "dispersible" solids and is the largest classification, since it includes all those materials containing moisture which can be separated into smaller masses or particles, such as crushed rocks, at one extreme, and filter cakes at the other. The third class might be called the "massive" or perhaps more accurately the "indispersible" type. This includes such materials as molded clay articles, textiles, paper, tobacco and the like, which cannot be broken up into smaller masses but must be handled as a unit.

In general, it must be remembered that in all drying problems it is far cheaper to remove moisture mechanically than by evaporation. Although this is axiomatic, it is ignored to an astonishing extent by those who design or specify drying machinery. Actually, there are many present installations which could have shown a profit had the above principle been applied. For instance, slurries and sludges can usually be vacuum filtered to a much lower moisture content and the residual water evaporated in an efficient rotary dryer. Instead, however, all the water present is often evaporated in the less efficient atmospheric drum dryer. This is but one example, but many similar ones will come to mind.

Liquids—In drying liquids, of course, and thin slurries which cannot be mechanically dewatered, we should first consider the preliminary step of efficient evaporation. Most direct dryers for liquids are inefficient as far as fuel or heating medium is concerned. Therefore, the use of a multiple-effect evaporator (or even a vacuum pan) may be required as a first stage. Having obtained a concentrate, this may be handled by means of a drum dryer internally heated, the liquid being spread by flowing or spraying as a film on the outside and the dried product being scraped off. Drum dryers come in a variety of shapes, sizes and designs. For delicate materials they may be operated under vacuum.

The concentrate may also be dried by means of a spray dryer in which the liquid is sprayed in contact with a current of warmed air. Almost instantaneous drying takes place with low temperature in the drying zone. This low temperature, of course, is attained through rapid evaporation and the lowering of the air temperature to approach its wet-bulb temperature. Spray dryers, because the air cannot leave the dryer with a high relative humidity, are comparatively inefficient thermally and are applicable only for handling the more highly priced and delicate materials. The dust from a spray dryer presents a fairly difficult problem in itself and ordinarily requires expensive dust collecting equipment.

Dispersible Materials—It was for the handling of this class of material that the earliest commercial dryers were built. At one time it was supposed that only heat was necessary to evaporate moisture and consequently industry became studded with inclosed rooms, partitioned off from the rest of the factory and provided with steam coils to supply that heat. It was only through years of trouble due to the omnipresent case hardening, baking and spoiling of materials that the thought was finally evolved that perhaps air circulation might eliminate the evils attendant upon the first primitive drying attempts. Thereafter, cabinets were made with removable trays on which the granular materials were spread and subjected to heated air circulation. A further important step was to place the trays on movable racks so that they could be pushed through tunnels, through which hot air was circulated, preferably in a direction counter current to the travel of the material. Thus was developed a more efficient drying system which had as its basic idea (although perhaps unconsciously developed) that the rate of drying from the surface of material need be no faster than the rate of diffusion of moisture through that material. Thus the control of humidity, either by length of tunnel or circulation of air, became a reality—and a reasonable efficiency was obtained.

There are on the market today a number of standard drying units of the tray and tunnel type, and all of the fan manufacturers will, upon request, design such machines to conform to the requirements. Do not, however, expect a thermal efficiency, referred to the steam supply, of more

Prepared for presentation at the June 1939 Summer School for Chemical Engineering Teachers at Pennsylvania State College, sponsored by the Society for the Promotion of Engineering Education.

than 50 per cent; 30 per cent would be nearer the actual figure.

A modification of the tunnel drying idea is obtainable in the traveling belt dryer, which practically eliminates labor by moving the material mechanically and automatically through the humidifying and drying zone. These several types, however, all have one failing in common—they are quite inefficient in regard to fuel consumption and the use of power.

A further refinement looking toward the achievement of economy in drying for most dispersible materials is the use of one of the many types of rotary dryer now on the market. Rotary dryers are adaptable to almost any drying problem in this class of material, and offer the highest efficiencies, usually the lowest cost of installation and practically automatic operation. Among the rotary dryers are seven or eight different types using steam, for instance, in tubes where the drying is done by direct contact. Others use steam for the heating of air passed through the revolving cylinder in contact with the material, while many are built to use gases from the combustion of fuel, either directly or indirectly for the evaporation of the water.

Many applications that heretofore have been thought capable of solution only by vacuum dryers can be handled by one or more of these rotary dryer types, especially the first two mentioned in the preceding paragraph. The steam tube dryer, for example, has a thermal efficiency of about 85 per cent referred to the steam supply, while some of the latest types of semi-direct direct-heat rotary dryers have an efficiency as high as 85 per cent referred to the *fuel*. This may be compared in general to efficiencies as low as 30 per cent in the tray, tunnel and traveling belt dryers.

There are other types of dryer for dispersible materials which are not so well known as those described above and these are used primarily for special materials. One of these types which has been on the market for a number of years is the "rabble" dryer, where the material is slowly hoed along the top of a heated hearth. This type has been useful for the handling of materials such as mineral concentrates. Another type which is often used, although not so well known, is the vertical dryer in which the material is raked or hoed in a circular path on a vertical series of heated hearths, or subjected to heated air traveling between them. It has been found that this type of dryer is a space saver which can be used for drying a number of crystalline materials without damage to their structure. This dryer is rather low in efficiency, but in its special application has no competitor.

Vacuum steam-jacketed dryers are also available, provided with paddles or stirrers for dispersible materials that must be handled under subatmospheric conditions, often where a solvent recovery problem exists. Similar machines operating at atmospheric pressure are sometimes used for packing house products.

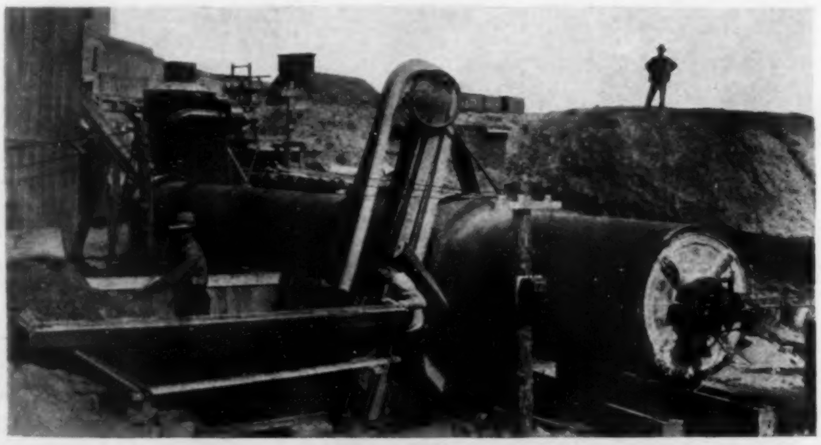
Massive Materials—I might say in passing that these materials require specially designed dryers—which, however, are standard with many manufacturers—but they may be handled in general by the same type of tunnel and traveling belt dryers as those mentioned in connection with dispersible materials. An important point is that massive substances, particularly molded clay articles, require even closer humidity control than do materials of the second class above mentioned. Since the rate of diffusion of moisture is very slow through such substances, the drying time must be made correspondingly longer.

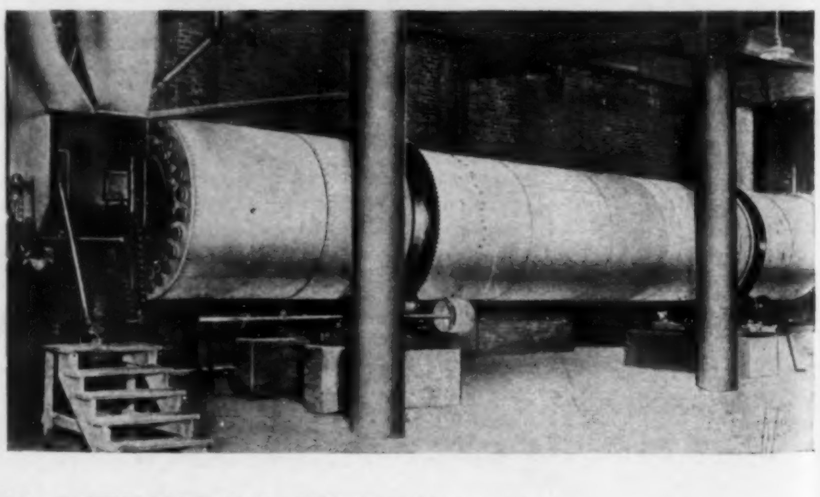
Textiles, paper, tobacco and the like are handled in dryers which, in general, are of long-tunnel or similar construction. Movement of large quantities of air with partial recirculation insures uniform evaporation under controlled conditions. Although such machines are inefficient thermally, no more efficient substitute has yet been found.

In closing it should be emphasized that efficiency in drying demands the lowest first cost of equipment, the lowest operating cost and the highest quality of product consistent with the overall economics of the process. A proper consideration of the drying factor and the use of the facilities offered by the dryer manufacturer are important steps in accomplishing these basic objectives.

Above—Parallel-current clay dryer at the plant of the Volz Fire Clay Co., St. Louis, Mo.

Below—Rotary steam tube dryer for distiller's grains at the Frankfort Distilleries, Louisville, Ky.



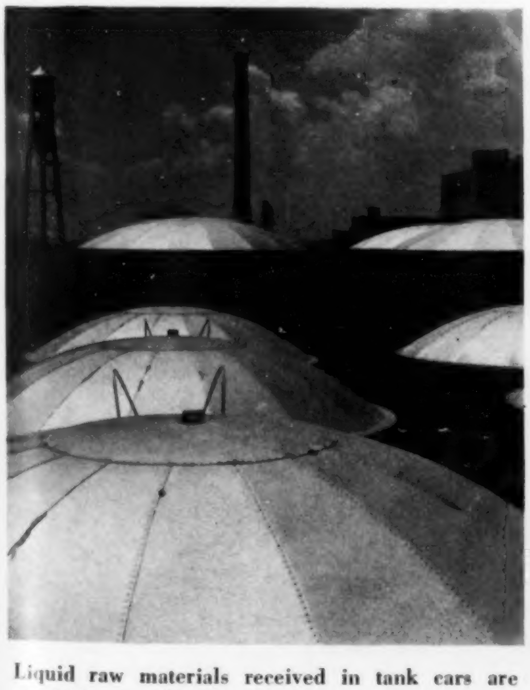


Phenolic Resin Production

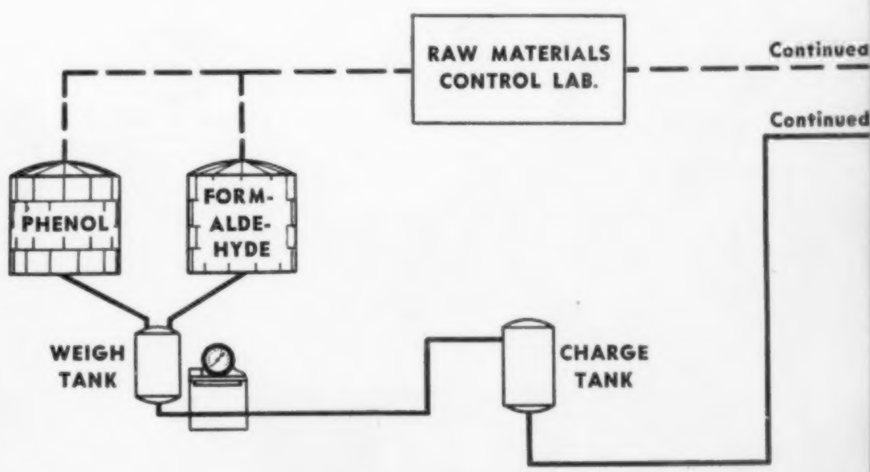
ONE OF THE NEWEST of all industries is the synthetic resin. It dates from February 1909, when Dr. Leo H. Baekeland announced the development of the phenolic resinoid to which he gave a modification of his name. This trade name now extends over a widely varied line of synthetic resinous products. In these 30 years, the synthetic resin industry has grown to be one of tremendous importance with as promising a future as any industry may develop.

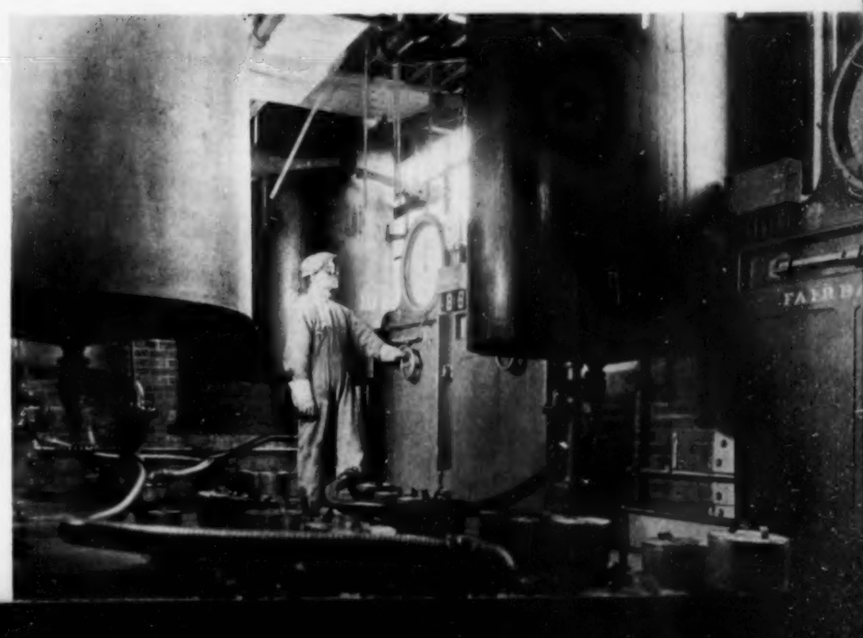
With industrial requirements becoming more exacting for improved types of synthetic resins and for color or transparency, for high frequency insulation, and other properties, new types of plastics were added to the phenolic line. These requirements and the rapidly increasing demand for synthetic resinous plastics were met with the construction seven years ago of a vast modern plant built on 100 acres of property at Bound Brook, N. J. Here, Bakelite Corp. produces phenolic, urea, polystyrene and cellulose acetate products. The accompanying diagrammatic and pictured flow sheets show the essential steps in the process used in this plant for production of the phenol-formaldehyde molding materials.

In the production of these resins remote control pumps force the liquid raw materials from great storage tanks to the top floor of the process building. After the chemicals are accurately weighed they flow by gravity into charging tanks and from them into the reaction vessels. When the reaction is complete, the liquid resin is drained into the pans. The cool solidified resin is dumped out and broken. From this point it follows one of two paths depending upon its ultimate utilization. The resin intended to be compounded in the molding material passes through a coarse grinder and is transferred to storage. The resinous binder and other ingredients are weighed, passed over magnetic separators and through pulverizers. The mixture then feeds into heated roll mills which further compound the mixture. The cooled mass is passed through reducing equipment, sifted and blended before packing in the drums for shipment. Extremely accurate control of the raw materials, finished products, and the products at almost every stage of the process, feature the production of Bakelite materials. For a more detailed description of the process used in this plant, see *Chem. & Met.*, pages 540–43, Vol. 42, Oct. 1935.

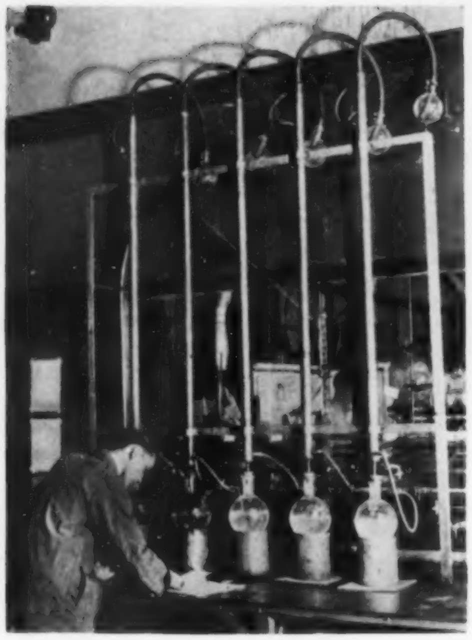


Liquid raw materials received in tank cars are carefully sampled for analyses before contents are pumped into raw material storage tanks

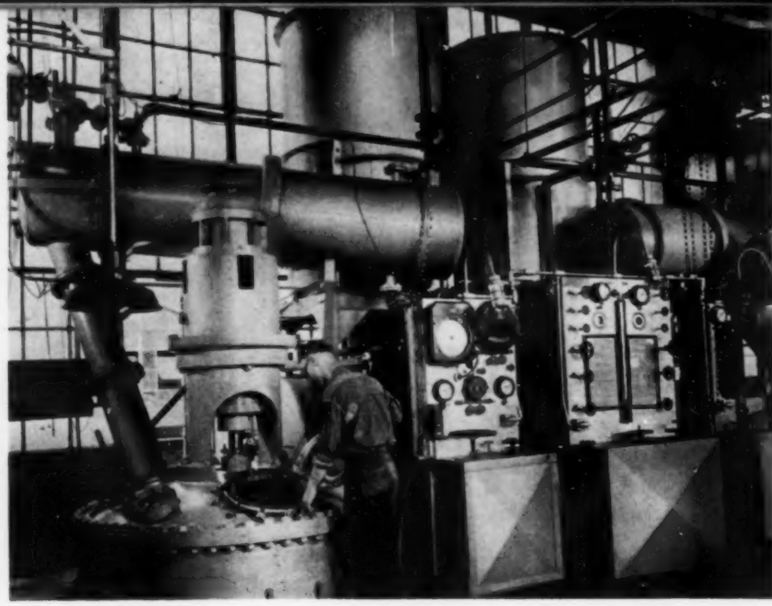




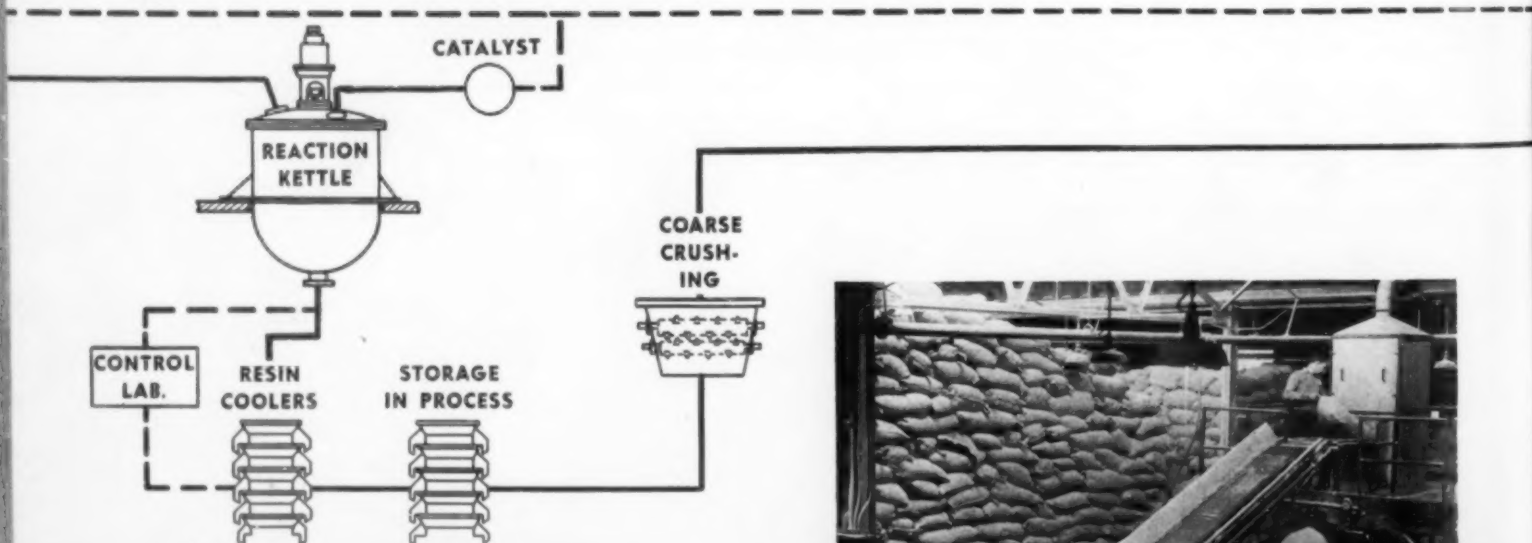
In the weigh room the ingredients for the resin reaction are carefully weighed in accordance with established formulas



Prior to the start of reaction, the still charge is carefully checked in the control laboratory

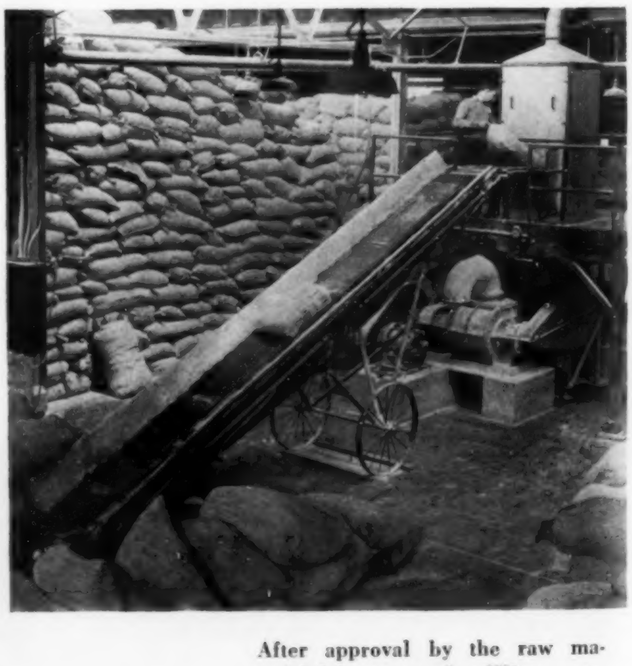


Resins for molding materials are prepared in the stills under carefully controlled conditions

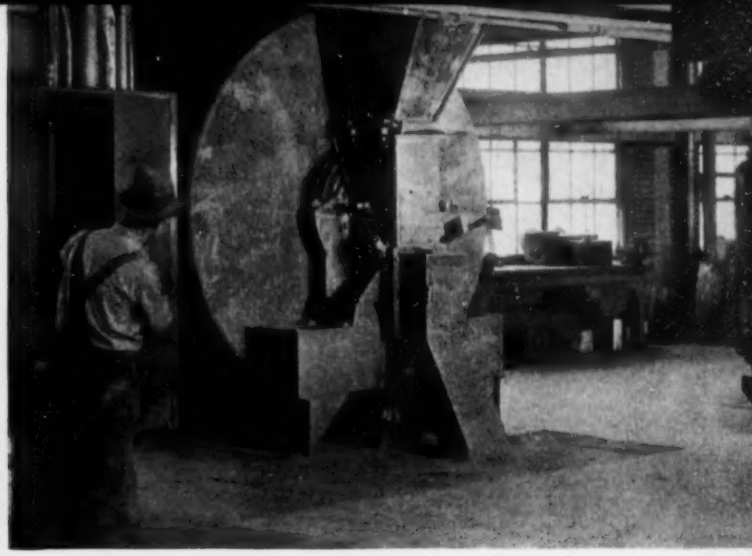


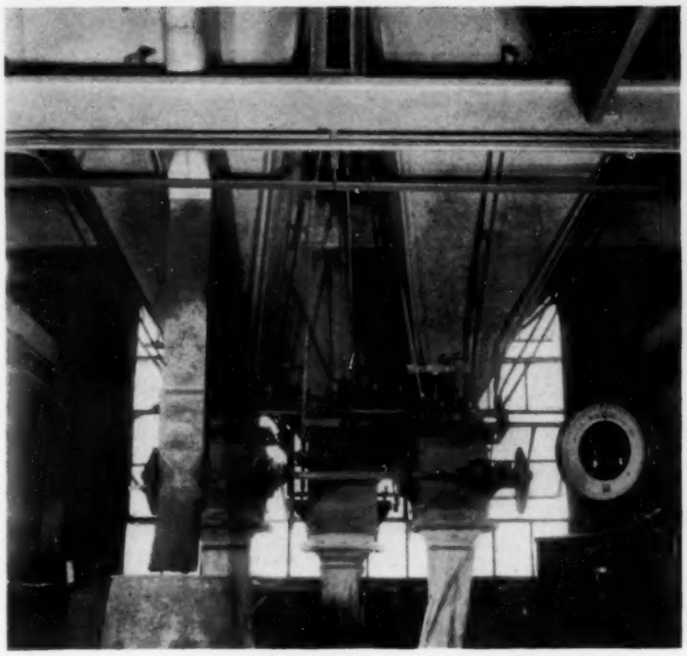
A Chem & Met PICTURED FLOW SHEET

After samples of the completed resin have been approved by the control laboratory, the molten resin is drawn from the still into containers and transported to temporary storage



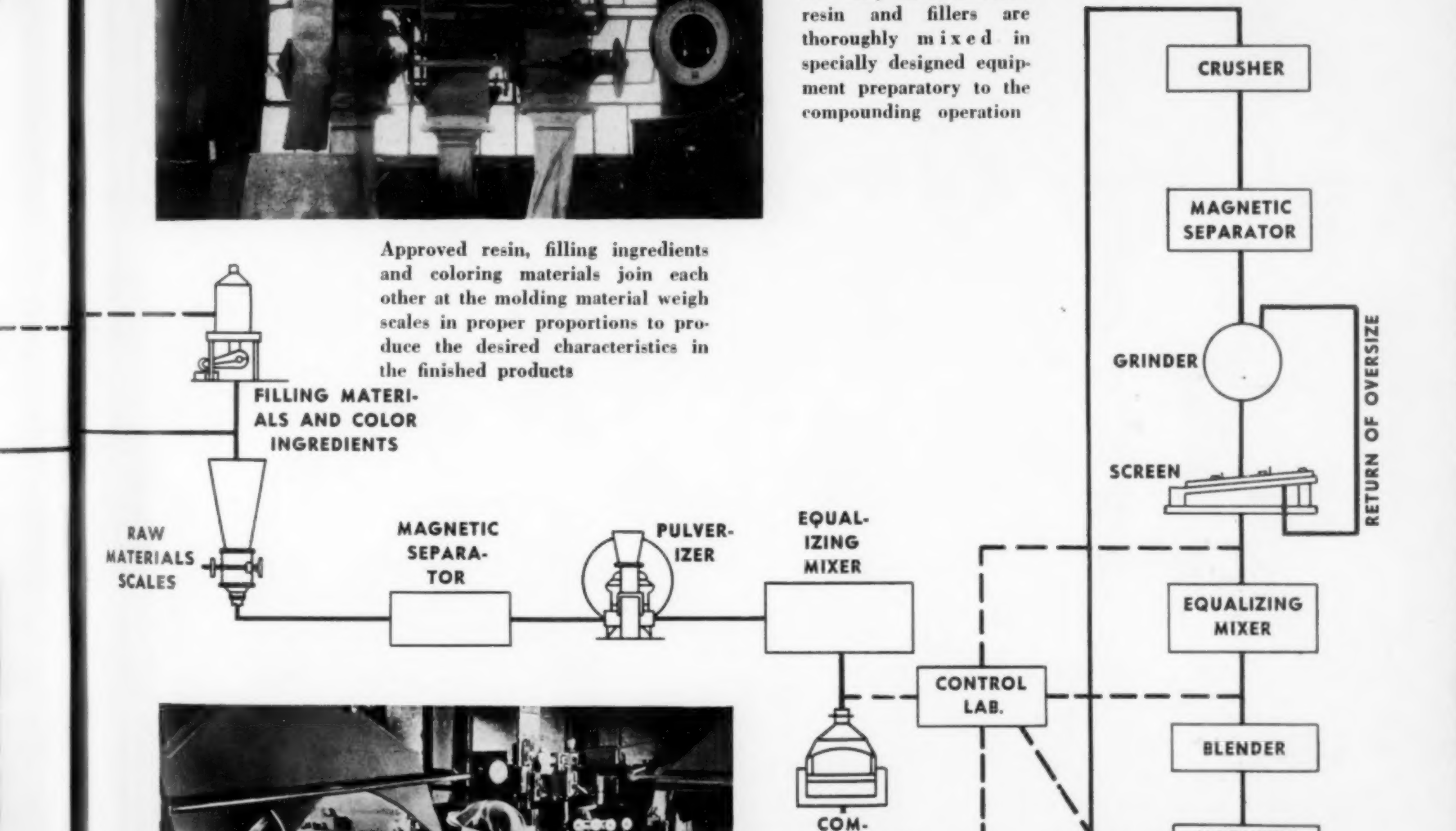
After approval by the raw material laboratory, the filling materials are transported from the raw material warehouse to the manufacturing area





In finely divided form, resin and fillers are thoroughly mixed in specially designed equipment preparatory to the compounding operation

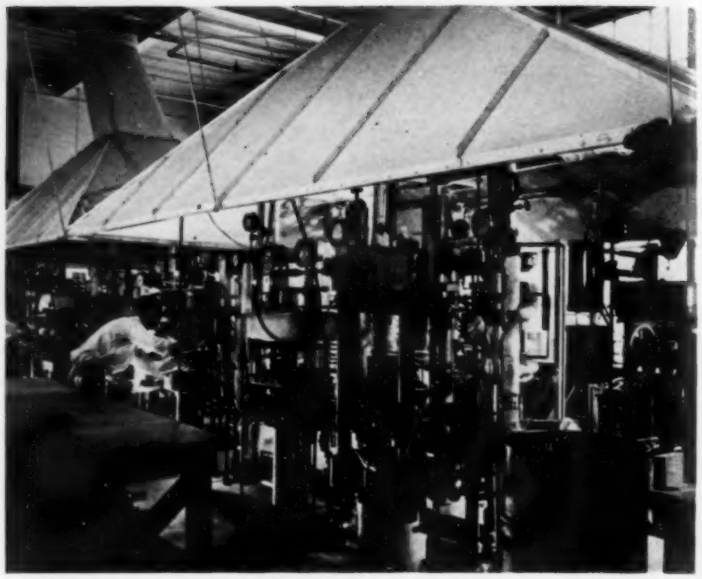
Approved resin, filling ingredients and coloring materials join each other at the molding material weigh scales in proper proportions to produce the desired characteristics in the finished products



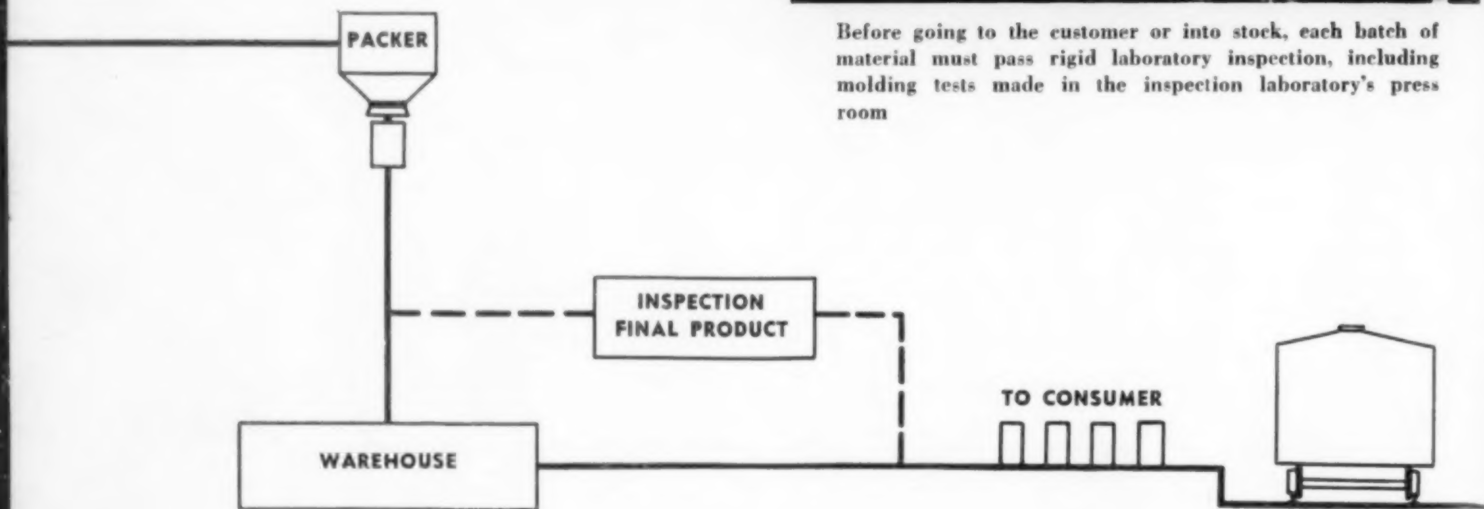
Between hot rolls the blended mixture is pressed to insure uniformity. Sharp blades scrape it from the rolls in thick sheets which are carried by cooling conveyors to the final stages of production

Uniform powder characteristics of the finished molding material are assured by careful screening

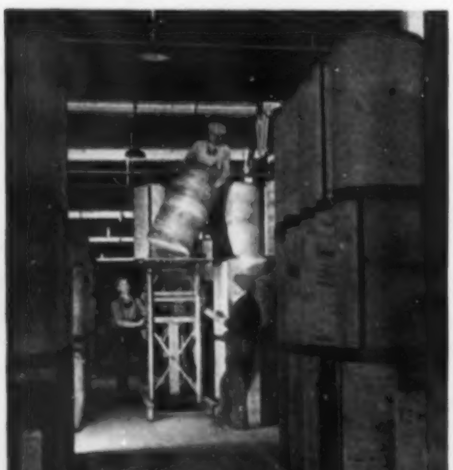
Drums march in formation along this helical conveyor to be filled with finished molding materials. Weight of each filled drum is checked at this point before it continues on its journey to storage or to customers



Before going to the customer or into stock, each batch of material must pass rigid laboratory inspection, including molding tests made in the inspection laboratory's press room



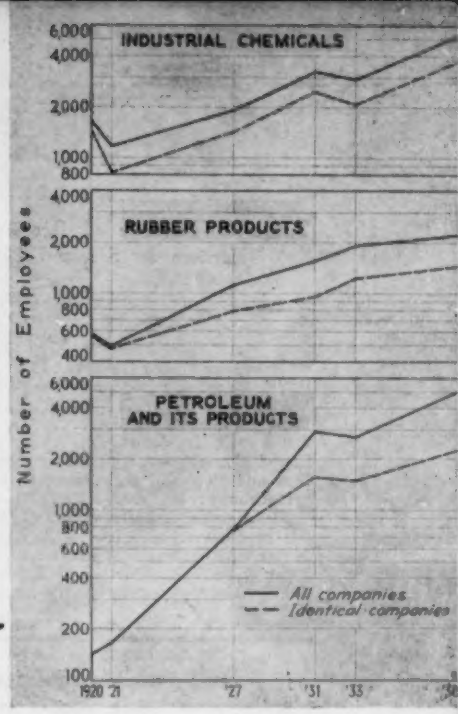
Filled drums are transferred to the storage warehouse, ready for prompt shipment to customers



Complete railway and trucking facilities expedite the movement of Bakelite materials to the nation's industrial centers

Growth of Research

Everyone connected with chemical process industries knows that research has grown in the last ten years. But how much it has grown, what type of personnel predominates and where industrial research is done are questions that require answers.



GEORGE PERAZICH

and

PHILIP M. FIELD

Engineers
Works Progress Administration
National Research Project

IT IS A WELL-KNOWN FACT that industrial research is today assuming an increasingly important role in our economy and has become essential for the solution of many industrial problems. On the basis of research, new production techniques are frequently developed; old methods, products or processes improved; production costs reduced; and much waste eliminated. The application of science in industry has been widely accepted and was an important factor in the advance of technology. With the development of modern research techniques, planning and coordination of production processes have also received greater emphasis, resulting in improving the level of efficiency of both labor and equipment. Where formerly the success of an enterprise may have depended chiefly on the judgment of individuals who often lacked scientific data, today it depends largely on the findings of a research laboratory and the quality of its staff and equipment.

In the United States, research has been growing very rapidly during the last two decades. According to the statistics compiled from a series of surveys made by the National Research Council, the number of companies maintaining research laboratories has grown from fewer than 300 in 1920 to more than 1,700 in 1938.[1] The total number of workers engaged in research and engineering development has grown from about 6,400 to more than 42,000 during the same period. Measured in terms of employment, the "research industry" can be counted today among the country's 50 largest industries.

Table I—Growth of Laboratory Personnel in Selected Industries, 1920-38

		Chemicals									
		Chemicals and allied products		Industrial chemicals		Petroleum and its products		Rubber products		Food and kindred products	
Year	All industries	All companies	139 identical companies	All companies	16 identical companies	All companies	24 identical companies	All companies	6 identical companies	All companies	42 identical companies
1920...	6,442	......	......	1,690	1,470	145	......	590	577	.....	.....
1921...	7,775	......	......	1,178	820	167	......	495	485	.....	.....
1927...	16,982	3,451	2,793	1,918	1,434	788	769	1,115	796	401	310
1931...	29,830	......	......	3,257	2,461	2,957	1,591	1,561	965	.....	.....
1933...	25,567	......	......	2,929	2,100	2,724	1,504	1,939	1,225	.....	.....
1938...	42,271	9,467	6,502	5,248	3,708	5,033	2,260	2,250	1,477	1,424	696

Much of the increase in research personnel in the country as a whole can be attributed to the expansion of activities in the chemical and process industries. These industries are not only among the largest employers of research workers but their staffs have been growing at a much higher rate than those of all manufacturing industries combined, including trade association, consulting, testing, and some foundation laboratories.

The industries selected for the purpose of this discussion include the petroleum, rubber, food and kindred products, and chemicals and allied products industries.[2] From the last group, representing as it does a broad Census classification, industrial chemicals are also separately tabulated.

According to the available statistical evidence, the four industries mentioned above employed in 1927 approximately 5,700 workers representing more than one-third of the total laboratory personnel in that year. In 1938, these industries employed in their laboratories about 18,000 workers and their share of the total personnel covered by the National Research Council surveys rose to nearly 45 per cent. While during the 11-year interval the growth of research in all manufacturing industries amounted to about 150 per cent, the four chemical and process industries grew by 215 per cent. Of the 25,000 persons added to the industrial laboratories during the period 1927-38, more than 10,000, or 40 per cent, were employed by the chemical and

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[1] At the time of this writing, a report dealing with the "Growth of Industrial Research in the United States, 1920-38," is being made ready for publication. The problems involved in the compilation and use of statistics are fully discussed in this report. This article summarizes some of the aspects of this study, with emphasis on the chemical and process industries, and was prepared with the permission of Mr. David Weintraub, Director of the WPA National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques.

[2] The definitions of these industries are the same as those used by the Census of Manufactures with the exception of petroleum and its products. In this case, the difference is due to the inclusion of oil producing as well as refining companies. There are also included companies engaged in developing and licensing petroleum refining equipment and prospecting companies. Industrial chemicals include bulk chemicals for industrial use and this category corresponds closely to the Census classification: "Chemicals not elsewhere classified," which is part of the Census Group VI.

Table II—Number of Research Workers per 10,000 Wage Earners in Selected Industries, 1927 and 1937

Industry	Number of Persons 1927	Number of Persons 1937	Percentage Increase, 1927–37
Chemicals and allied products	136	301	121.3
Petroleum refining (not incl. crude oil prod.)	95	563	492.6
Rubber products	78	173	121.8
Food and kindred products	6	16	166.7
Electrical machinery, apparatus, and supplies	...	116	.....
Iron and steel and their products, excluding machinery	6	15	150.3
Blast furnace and steel work and rolling mill products	6	16	166.7
Motor vehicles, bodies and parts	18	41	127.8
Paper and allied products	12	28	133.3
Textiles and their products	0.7	2	185.7

Table III—Occupational Distribution of Laboratory Workers in Four Selected Industries, 1938

Occupation	All Industries (1,224 Companies)	Chemicals Allied Products (290 Companies)	Petroleum and Its Products (37 Companies)	Rubber Products (26 Companies)	Food and Kindred Products (77 Companies)
	Percentage Distribution				
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Directors	4.1	4.8	1.3	5.4	5.3
Engineers	23.2	11.7	13.9	26.3	9.2
Chemists	28.5	51.0	19.8	22.6	47.3
Physicists	3.5	1.5	9.3[a]	1.3	0.7
Metallurgists	3.3	0.7	0.3	....	0.5
Laboratory assistants	16.9	10.3	33.8	33.2	15.6
All others[b]	20.5	20.0	21.6	11.2	21.4

[a] Includes geophysicists.
[b] Includes other scientists, technicians, maintenance workers, clerks, administrative employees and unspecified occupations. For the 1,224 companies, other scientists equal 8.5 per cent, technicians, etc., 11.4 per cent, and unspecified, 0.6 per cent.

Table IV—Geographical Distribution of Laboratory Personnel in Four Selected Industries—1927 and 1938

State	All Industries 1927	All Industries 1938	Chemicals and Allied Products 1927	Chemicals and Allied Products 1938	Petroleum and Its Products 1927	Petroleum and Its Products 1938	Rubber Products 1927	Rubber Products 1938	Food and Kindred Products 1927	Food and Kindred Products 1938
Total for all reporting companies	16,982	42,271	3,451	9,467	788	5,033	1,115	2,250	401	1,424
Total for Ten States	14,834	36,959	2,929	8,355	608	4,065	1,058	2,230	284	1,085
California	500	1,497	36	130	272	794	.....	.....	38	105
Delaware	730	1,613	725	1,573	.....	.....	.....	.....	.....	.....
Illinois	1,810	4,527	151	462	98	358	.....	15	64	378
Indiana	401	1,282	120	244	89	394	6	.....	28	49
Massachusetts	618	2,028	59	228	.....	.....	58	65	6	24
Michigan	954	2,993	194	923	.....	5	.....	.....	18	19
New Jersey	1,787	6,057	578	1,895	48	982	200	549	2	162
New York	4,508	7,514	587	1,366	.....	191	8	40	86	239
Ohio	2,100	4,763	218	768	.....	16	786	1,539	29	80
Pennsylvania	1,426	4,685	261	766	101	1,325	.....	22	13	29

petroleum industries. In view of the character of their production processes and the fact that these industries operate at a relatively high technological level, it is not surprising that they should show the most rapid growth.

Of all industries which maintain research laboratories, "chemicals and allied products" have the largest staffs. As is shown in Table I, in 1938 the group of industries covered by this Census classification employed nearly 10,000 research workers as compared with less than 3,500 in 1927. Half of them were working in laboratories owned by manufacturers of industrial chemicals and, as the data in Table I show, these have grown at an even more rapid rate than the more inclusive group representing chemicals and allied products. The number of research organizations connected with the manufacture and sale of industrial chemicals rose from 20 in 1920 to 54 in 1938 while their staffs grew from less than 2,000 to more than 5,000 during the same period. This increase can be attributed to the establishment and growth of new research laboratories as well as to the expansion of older laboratories organized prior to 1920. The latter was an important factor, for the data show that 16 identical establishments, employing more than 80 per cent of all laboratory workers represented by this group, grew from about 1,500 workers in 1920 to about 3,700 in 1938. The expansion of research staffs in a few large companies contributed most to this growth.

Among the major industries which maintain laboratories, the growth of petroleum research was the most rapid. Although this industry commenced its extensive research programs much later than the chemical or electrical industries, it has nevertheless caught up and perhaps surpassed them. Next to chemical, the petroleum industry employs the largest number of laboratory workers, and with the exception of radio, it has grown more rapidly since 1927 than any other industry which furnished data. According to the available evidence, in 1927 less than 1,000 employees were engaged in petroleum research as compared with more than 5,000 in 1938. A great deal of this growth can be attributed to new establishments but the expansion of old laboratories also was an important factor. As is shown in Table I, the staffs of 24 concerns grew from about 770 persons in 1927 to approximately 2,200 in 1938.

The automobile and aviation industries have provided a great stimulus to petroleum research and improvements in automobile engine design, which resulted in an increase in the average compression ratio from 4.55 in 1927 to 6.28 in 1939. This has made imperative the development of gasoline with high octane rating.

The rubber industry is also an important employer of research workers. As Table I shows, its laboratory personnel grew from about 600 in 1920 to 2,200 in 1938. For the six identical companies which employed more than two-thirds of all research workers in the industry, the personnel increased from less than 600 to nearly 1,500 during the same period. Investigations designed to improve physical and chemical properties of rubber were among the most important activities. A great deal of research effort was also expended on the study and design of construction of tires and of tire making machinery. That these efforts have been successful is illustrated by the fact that the average mileage per pound of tire has increased over 200 per cent since 1914.

The food industry, while a relatively unimportant employer of research workers, was also growing rapidly during the last decade. In 1938, more than 1,400 workers were doing research on the improvement of canning and processing of different food products. Laboratories working on the development of quick-freezing meth-

ods and improved canning techniques were primarily responsible for the more than 200 per cent increase in the research personnel since 1927.

The relative magnitude of research in various industries, as well as its growth, is even more clearly revealed when the laboratory staffs are compared with the number of wage earners. We have done this in the case of nine selected industries listed in Table II. On the assumption that laboratory personnel in 1937 was approximately the same as in 1938, this table indicates that for each 10,000 wage earners there were 301 research workers employed in the chemicals and allied products industries, 563 in petroleum refining, 173 in rubber products, and 16 in the food industry. It is furthermore observed that with the exception of food, the four industries considered in this paper have the highest ratio of laboratory workers to total wage earners. During the decade 1927–37 the increase in this ratio was largest in the petroleum industry, with textiles, food, iron and steel, and motor vehicles, following next in order of importance.

Another interesting fact about the industries considered here is that their average staffs are much larger than those of all industries combined and with the exception of rubber they have experienced a much sharper growth since 1927. It is found, for example, that in 1938, while the average number of employees per company based on all reporting companies was about 25 persons, industrial chemical producers had an average staff of 97 persons as compared with 95 in the petroleum industry and 64 in the rubber industry.

Between 1927 and 1938, the average staffs of the four chemical and process industries considered above grew by 83 per cent while the growth of all manufacturing industries amounted to only 34 per cent. The average number of research workers per company in the petroleum industry grew by about 240 per cent as compared with 180 and 103 per cent respectively for the industrial chemicals and food and kindred products industries.

The increase in the average staff has been largely due to the growth of the laboratories of comparatively few large companies which employ most of the research personnel. An examination of all industries shows that in 1938 one-fourth of the companies reporting laboratories employed about 80 per cent of all research workers. For the selected industries a similar situation is found. In rubber, one-fourth of the companies reported over 90 per cent of the total research workers in the industry while in petroleum and industrial chemicals the corresponding figures were 85 and 88 per cent respectively.

Occupations of Research Workers

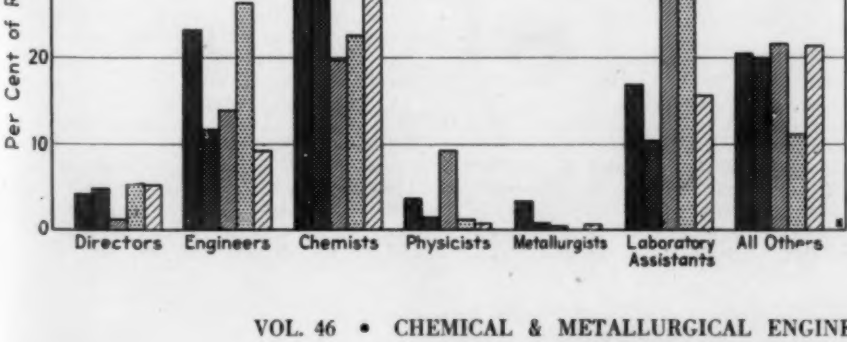
The problems of many research laboratories are usually complex and the development of a new process or product is rarely the result of research in a single field as, for example, chemistry or engineering. As an investigation proceeds from theoretical assumptions through various stages of testing and experimentation there are a large number of widely varying problems that must be solved. Chemical analysis may provide the solution of some of these problems while others may be solved by means of physical testing or an inquiry of an engineering nature. Yet, in almost every case before a new product is turned out, chemists, engineers, metallurgists, physicists, and many other types of specialists will have contributed to its development.

In this connection, it is therefore of interest to examine the composition of laboratory personnel. As is shown in Table III and the chart below, containing data from 1,224 reporting companies representing all industries, in 1938 chemists and engineers comprised nearly half of the total laboratory personnel. Laboratory assistants accounted for about 17 per cent, metallurgists and physicists for less than 4 per cent each, while all other occupations including biologists, bacteriologists, ceramists, and many nonscientific workers such as technicians and maintenance, administrative and clerical employees accounted for approximately 20 per cent.

In the 290 companies included in the chemicals and allied products industries, chemists accounted for more than half of the total personnel. In the rubber and petroleum products industries, laboratory assistants comprised the largest single occupation, representing one-third of the total personnel. Of the 37 companies engaged in petroleum research, engineers amounted to approximately 14 per cent of the total personnel as compared with 20 per cent chemists, and 9 per cent physicists. For the 26 companies manufacturing rubber products, engineers were the largest professional group and comprised more than 26 per cent of laboratory personnel; chemists represented about 23 per cent. The relatively large proportion of physicists in the petroleum industry can be attributed largely to the fact that geophysicists are also included in this category.

In the more detailed report on industrial research on which this paper is based an occupational analysis of 177 identical companies shows that from 1927 to 1938 metallurgists have experienced the most rapid growth of all occupations. This may be attributed in part to the demand for new alloys and heat treating processes which were extensively introduced during the past decade.

Occupations of laboratory workers in selected industries for 1938



Electrochemical Developments

EDITORIAL STAFF REPORT

Francis C. Frary
Acheson Medallist

The fall meeting of the Electrochemical Society is being held in New York City as we go to press. An extensive program of technical papers was prepared for the sessions devoted to influence of cathodic reactions on corrosion, electro analysis, electrodeposition, batteries, and other subjects. Electrochemical Day at the Fair and the Acheson Medal Dinner were among the principal social events scheduled for the convention.

September 11 was set aside by the authorities as Electrochemical Day at the New York World's Fair. Members of the society and guests spent the afternoon and evening at the Fair. They inspected exhibits of electrochemical interest, including the special performances at General Electric Co.'s House of Magic and Steinmetz Hall. At five o'clock, Prof. Bradley Stoughton of Lehigh University gave an address in the Little Theatre at the Science and Education Building. His theme was Modern Marvels of Electrometallurgy. This was the Sixth Joseph W. Richards Memorial Lecture. A dinner at the Cafe Turf Trylon brought the formal program at the Fair to a close.

On September 12, the Edward Goodrich Acheson Medal Dinner was held at the Hotel Commodore. The Medal and $1,000 prize were bestowed upon Dr. Francis C. Frary, director of research of the Aluminum Company of America, in recognition of his outstanding accomplishments in electrometallurgy. At the presentation ceremonies directly following the dinner, Mr. Junius D. Edwards of the Aluminum company talked on Frary's scientific and technical accomplishments and Mr. S. D. Kirkpatrick, editor of *Chem. & Met.*, spoke on Frary as a friend and associate. The medalist then reviewed his years of experience in electrometallurgy.

The first technical session was devoted to Recent Progress in Electro Analysis. It was presided over by Prof. Hiram S. Lukens of the University of Pennsylvania.

Electrotitrations—A Review of Recent Trends, by N. Howell Furman, Princeton University, Princeton, N. J.

Internal Electrolysis as a Method of Analysis, by B. L. Clarke and L. A. Wooten, Bell Telephone Labs., New York City.

Bradley Stoughton
Richards Memorial Lecturer

A Pulse Amplifier for Performing Differential Electrometric Titrations, by Henry H. Baker, Jr., and R. H. Muller, Trinity College, Hartford, Conn., and New York University, New York City, respectively.

Detection of Small Traces of Copper with the Antimony Electrode, by G. A. Perley, Leeds & Northrup Co., Philadelphia, Pa.

Measurements with the Dropping Mercury Electrode, by G. A. Perley, Leeds & Northrup Co.

Electro Analytical Estimation of Rhenium, by O. Tomicek and F. Tomicek, Charles University, Prague, Czechoslovakia.

Polarization and Overvoltage with Special Attention Given to Transfer Resistance, by A. L. Ferguson, University of Michigan, Ann Arbor, Mich.

New Theory of Overvoltage, by H. Eyring, S. Glasstone and K. J. Laidler, Frick Chemical Lab., Princeton, N. J.

New Cathodic Process for Production of Hydrogen Peroxide, by E. Berl, Carnegie Inst. of Technology, Pittsburgh, Pa.

The second technical session was given over to the subject of Influence of Cathodic Reactions on Corrosion. Dr. Robert B. Mears of the Aluminum Co. of America presided.

Study of Cathodic Reactions in Metallic Corrosion, by T. P. Hoar, University of Cambridge, Cambridge, England.

Observations on the Behavior of Steel Corroding Under Cathodic Control in Soils by I. A. Denison and R. B. Darnielle, National Bureau of Standards, Washington, D. C.

Classification of Anodic and Cathodic Inhibitors, by E. Chyzewski and U. R. Evans, Cracow, Poland, and Cambridge, England, respectively.

Nature of the Cathode in Rusting of Iron, by Sven Brennert, A. B. Separator, Stockholm, Sweden.

Cathodic Behavior of Zinc Versus Iron in Hot Tap Water, by Gerhard Schikorr, Berlin-Dahlem, Germany.

Electrochemical Studies of Corrosion of Steel and Magnesium in Partly Inhibited Solutions, by L. J. Benson, R. B. Mears and R. H. Brown, Aluminum Co. of America.

Rate of Solution of Zinc and Aluminum while Cathodic, by B. P. Caldwell and V. J. Albano, Brooklyn Polytechnic Inst., Brooklyn, N. Y., and Bell Telephone Labs., New York City, respectively.

Electrochemical Study of Corrosion of Painted Iron, by H. E. Haring and R. B. Gibney, Bell Telephone Labs., Summit, N. J.

Studies in Tarnish, by W. E. Campbell and U. B. Thomas, Bell Telephone Labs., Summit, N. J.

Electrometric Estimation of the Tarnish Products on Silver and Copper Alloys by L. E. Price and G. J. Thomas, University of Cambridge.

The Formation of Hydrogen Peroxide During Corrosion Reactions, by J. R. Churchill, Aluminum Co. of America.

The final session of the convention was devoted to electrodeposition, batteries, etc. The Electrodeposition Division of the Society was in charge.

Electrodeposition of Lead from Solutions of Lead Sulfamate with Addition Agents by F. C. Mathers and R. B. Forney, Indiana University, Bloomington, Ind., and Terre Haute, Ind., respectively.

Porosity of Electrodeposited Silver on Steel, by F. C. Mathers and L. I. Gilbertson, Indiana University.

The Rate of Decomposition of Hydrogen Peroxide in Nickel Sulphate Plating Baths by Gerald U. Greene, Fenn College, Cleveland, Ohio.

Anodes for Electrowinning of Manganese, by Colin G. Fink, and Morris Kolodney, Columbia University, and College of the City of New York, New York City, respectively.

Electrolytic Preparation of Sodium Arsenate, by Leo Lowenstein, Berlin-Wilmersdorf, Germany.

Cadmium Nickel Storage Batteries by Anna P. Hauel, New York City.

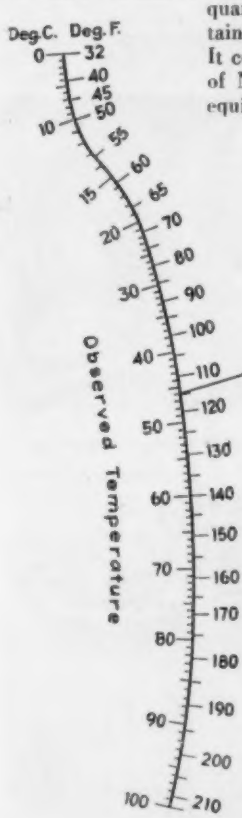
Rectifier Equipments in the Electrochemical Field by F. L. Kaestle, General Electric Co., Schenectady, N. Y.

Nomographic Chart for the Temperature Correction of Caustic Soda Solution Densities and Interconversion of Physical Data

By ERNST BERL
Research Professor
Carnegie Institute of Technology
Pittsburgh, Pa.

This chart differs from Charts I to V and is similar to Chart VI of this series in that the correction scales are in two parts, one for correction to a standard temperature of 15 deg. C. (59 deg. F.) and the other for corrections to a standard temperature of 100 deg. C. (212 deg. F.). The two sections of the chart are separated by the heavy lines indicating discontinuity in the scales for corrected density and grams per liter. Caustic soda solutions up to 51 per cent NaOH are liquid at 15 deg. C. (and some percentages considerably below this figure). Solutions of more than 51 per cent NaOH have a rising solubility curve and must be measured at a higher temperature. All concentrations to 70 per cent remain liquid at 64 deg. C. and above. Since the few available data at high concentrations are at 100 deg. C., this temperature has been taken as standard for concentrations of 51 per cent and above.

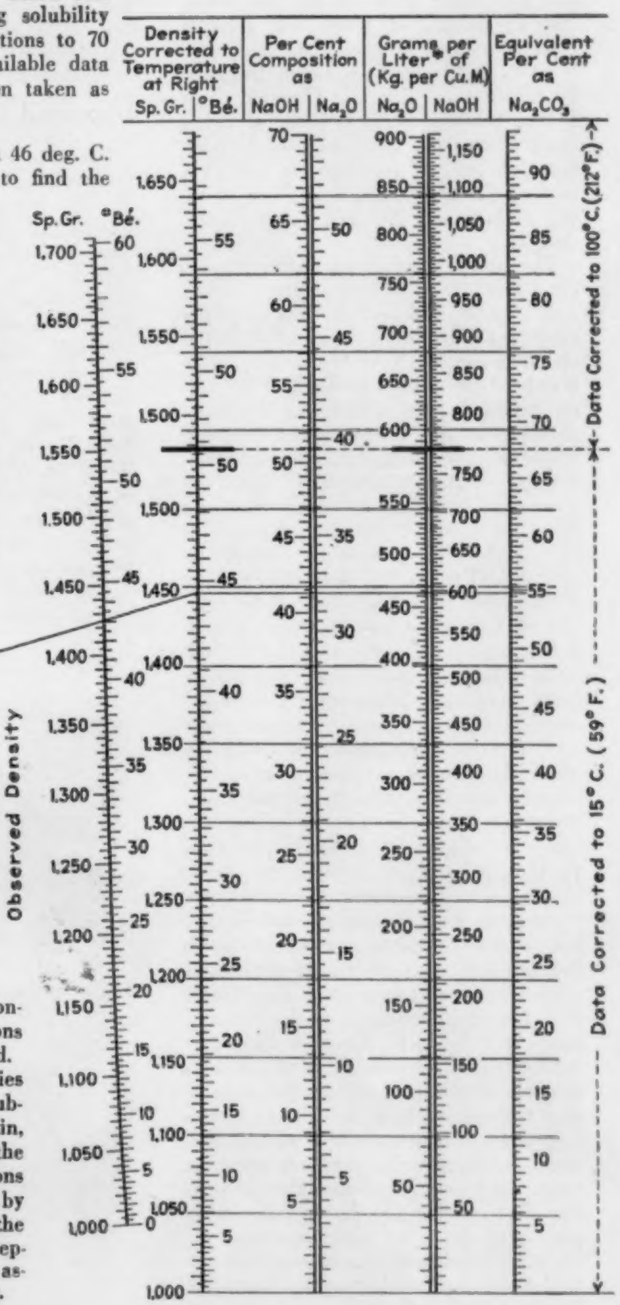
Example: A solution of caustic soda is tested with a hydrometer at 46 deg. C. and shows a specific gravity of 1.425 (43 deg. Bé.). It is desired to find the specific gravity and Baumé corrected to 15 deg. C. (59 deg. F.) and also the composition and grams per liter (kg. per cu. m.) in terms of NaOH and Na_2O and the equivalent percentage composition as sodium carbonate. With a straight edge connect the observed temperature, 46 deg., with the observed specific gravity, 1.425, and extend the line to the corrected density scale for 15 deg. C. standard temperature, cutting the latter at a gravity of 1.446 (44.5 deg. Bé.). To determine the physical properties corresponding to the corrected density extend a horizontal line to the right, cutting the several scales at the desired quantities. Thus it is found that the sample contains 41.3 per cent NaOH and 32 per cent Na_2O. It contains 462.5 grams per liter (kg. per cu. m.) of Na_2O and 597 grams per liter of NaOH. The equivalent percentage as Na_2CO_3 is 54.7.



Warning: Corrections of solutions containing over 51 per cent of NaOH are handled exactly as above. However, the data for such solutions are not complete and the completion of the chart above the heavy lines was partly by extrapolation. Consequently accuracy equal to that for solutions of less than 51 per cent cannot be expected.

Note: This chart is the seventh of a series translated from a more extended series published in 1930 by Julius Springer of Berlin, under the title of "Nomographic Charts for the Chemical Industry." The data for solutions above 51 per cent NaOH have been added by the editor, using information supplied by the Mathieson Alkali Works. In the original preparation of these charts Dr. Berl had the assistance of Drs. W. Herbert and W. Wahlig.

Chart VII



*For pounds per cubic foot divide by 16.02.

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Machinery, Materials and Products

Glass Acid Pump

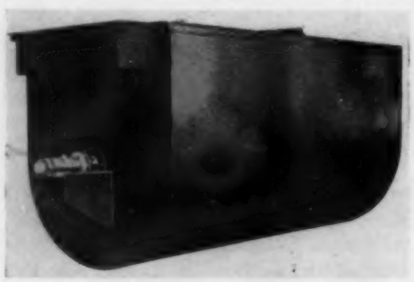
A PUMP claimed to have the mechanical advantages of metal and the chemical advantages of glass, has recently been announced by the Nash Engineering Co., South Norwalk, Conn. Designed in cooperation with the Corning Glass Works, the new pump is made of Pyrex brand corrosion-, heat- and shock-resisting glass and is available for operation at temperatures to 150 deg. F. in standard designs and 200 deg. F. in special designs.

The pump is of the centrifugal type, consisting of a two-piece glass casing and a glass impeller, the casing being supported within a corrosion-proofed metal casing which holds the two halves together by spring pressure. This feature automatically relieves the discharge pressure of the pump should it build up to a point dangerous to the glass. Normal operating capacities range upwards to 6,000 g.p.h., with discharge pressures to 50 lb. per sq.in. Cut-outs in the metal casing permit the contents of the pump to be viewed through the glass at any time. For cleaning the interior of the pump may be laid open in a few minutes, re-assembly being accomplished quickly and proper adjustment being practically automatic. A new mechanical acid proof seal has been developed for the stuffing box, the design of which is such as to assist the spring-loaded casing in the relief of overpressure.

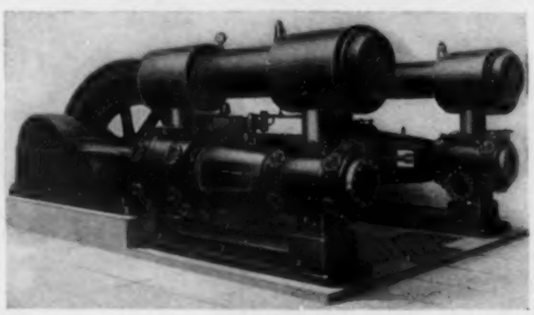
Jacketed Mixer

DESIGNED as a glue mixer and melter, but equally suitable for other heavy fluids which must be mixed or melted under uniform temperature conditions, is a 2,500-gal. horizontal mixer recently announced by L. O. Koven & Bro., Jersey City, N. J. As shown in the accompanying illustration, this mixer consists of a rectangular ⅜-in. steel tank with a half-round bottom supplied with a full steam jacket of ⅜-in. steel and equipped with a horizontal multi-paddle agitator. The outer jacket in the round bottom portion of the mixer is of particular interest. Two hemispherical segments of steel were used, welded to the single end pieces at each end and to each other in the middle. Riveted staybolts between the inner and outer tanks were used to provide rigidity and strength which could not have been obtained by simple welding of a tank of this diameter and length.

2500-gal. horizontal jacketed mixer



Improved horizontal tandem duplex compressor



Improved Compressors

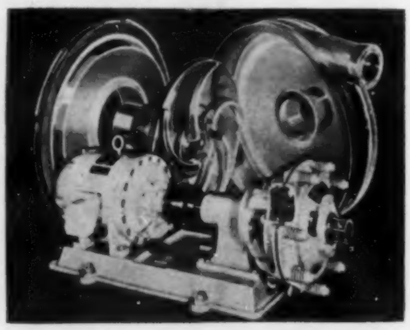
SEVERAL IMPROVEMENTS in its large tandem duplex compressors, as well as in its horizontal duplex dry-vacuum pumps have been announced by the Chicago Pneumatic Tool Co., of 6 East 44th St., New York, N. Y. The improved compressors, known as Class O-CTE, have the pistons on one side of the same size and weight as those on the other, thus equalizing inertia and air loads of the two sides. Either side can be operated alone, giving half capacity. Cylinders, pistons and valves are smaller and hence easier to handle than those of an equivalent two-cylinder unit. These compressors are designed for five-step regulation at full, three-quarters, one-half, one-quarter and no load.

The improved motor-driven vacuum pumps referred to are known as Class 01-DB. These pumps are of the horizontal, duplex, double-acting, water-cooled type arranged for flat belt, V-belt, direct-connected motor or steam drive. Furnished in a wide range of sizes, they may be had for either single or two-stage operation. Particular design features are the use of valves arranged parallel to the piston faces to minimize clearance losses; automatic water relief and drain valves in each cylinder head; and hand-operated relief valves for starting.

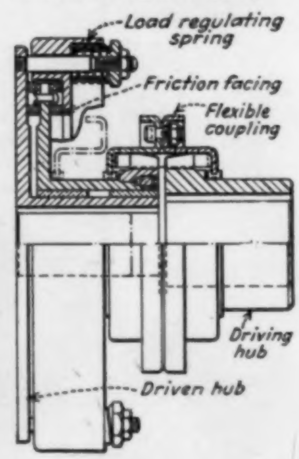
Controlled Torque Coupling

WHAT IS described by the manufacturer as a mechanical circuit breaker and shock absorber for the protection of mechanical equipment is the new con-

New glass centrifugal pump showing glass parts



Controlled-torque coupling



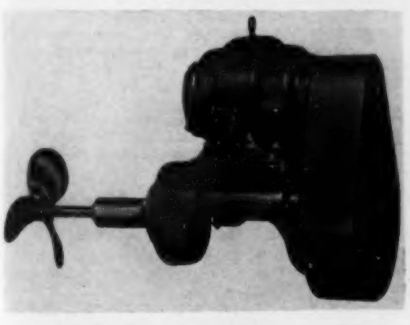
trolled torque Steelflex coupling recently announced by the Falk Corp., Milwaukee, Wis. This device combines in one unit a standard Falk flexible coupling and a friction clutch said to deliver any desired maximum torque up to the full capacity of the device. The clutch slips under instantaneous high peak loads and so protects connected machinery. Designed to damp out ordinary shocks and reduce vibration, the coupling is claimed to allow end float and provide for both parallel and angular shaft misalignment. As shown in the accompanying illustration, adjustment of the clutch is readily accomplished through the setting of a number of adjusting nuts which vary the spring loading on the friction facings.

Redesigned Mixer

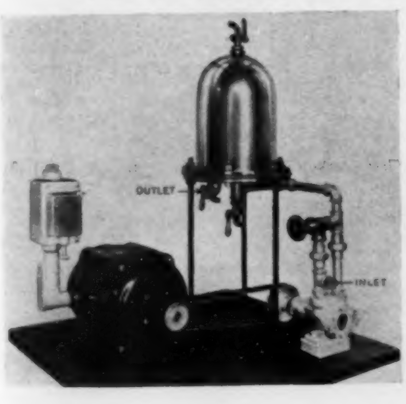
Mixing Equipment Co., Rochester, N. Y., has redesigned its side-entering V-belt mixer shown in the accompanying illustration. By changing from cast to welded metal, considerable savings in weight and price have been effected. The motor is mounted on a pivoted steel platform permitting maximum adjustment of the belt tension. Ready dismounting of motor and belts is claimed. A cartridge type rear bearing permits easy inspection and maintenance, the support bracket acting as a shield and protection for the bearing members. The V-belt drive is recommended for quietness and for ready interchange of motors. However, silent chain drives may be had if desired.

According to the manufacturer, side-entering propeller type mixers are being used to an increasing extent in tanks of all sizes. For example, two or more mixers of this type are said to be economically agitating contents of tanks holding 5,000,000 gal. or more of thin fluids such as gasoline. Such equipment, however, is also used for small tanks, particularly where the top of the tank must be kept clear.

Redesigned side-entering agitator



Type JG all-purpose filter



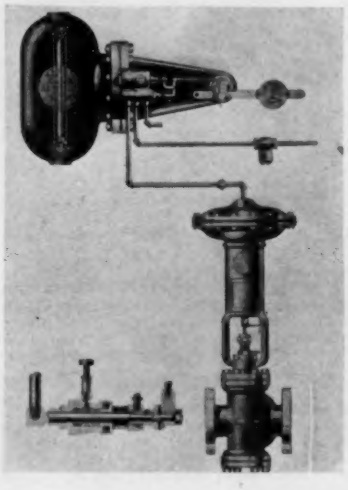
Small Universal Filter

A small all-purpose filter known as the Seitz Type JG has been announced by the American Seitz Filter Corp., Paterson, N. J. The filter proper is $7\frac{3}{4}$ in. high and $5\frac{1}{2}$ in. in diameter, having a capacity on water up to 300 g.p.h. at 25 lb. pressure. Pressures up to 50 lb. may be used. Various filter media are provided depending on the liquid being filtered, as well as screens alone for the straining of viscous liquids. The filter has two inner cylindrical screens with a $\frac{3}{4}$ in. space between which is filled with loose asbestos, pulp, charcoal or other filtering agent. Passage of the liquid is from the inside of the filtering cylinder outward. The filter is sold alone for attachment to any pipe line or with cast iron base, pump, motor and bypass arrangement as shown in the illustration. Standard construction employs tinned bronze with Monel metal screening, but other materials are available. Larger sizes are built, but multiple unit installations are recommended on the same base to permit continued operation during cleaning.

New Level Controller

An improved line of liquid level controllers having floats ranging from 6 to 12 in. in diameter has been announced by Kieley & Mueller Co., 40 West 13th St., New York, N. Y. Controllers of this line are made with bodies of cast steel, semi-steel, alloy steel or other special constructions including lead-lined, for acid service. An important feature of the design is the ball-bearing stuffing box from which the packing is completely removable without breaking the connection of the box in the float chamber. Efficient lubrication of the shaft is said to minimize metal-to-metal contact and reduce frictional losses so that valves up to 2 in. may be operated directly through a 6-in. float. In the accompanying illustration, the controller is shown operating a diaphragm valve through a pilot system.

Improved level controller



Equipment Briefs

Conco Engineering Works, Mendota, Ill., has introduced a new line of completely inclosed cable and drum type electric hoists featuring double-drum construction, push-button control, electric brake and heavy duty construction throughout. The new hoist, known as the Conco Torpedo, is available for either trolley, hook or lug suspension, in capacities from 250 to 1,000 lb. Dust-proof construction, a high factor of safety and the use of anti-friction bearings for all gear shafts are features of the construction. Extremely low price is another feature.

Several improvements have been incorporated in a new line of roller bearing troughing and return idlers recently patented by Robins Conveying Belt Co., 15 Park Row, New York, N. Y. A triple grease seal assembly is used to prevent the escape of grease or the entrance of grit or moisture into the bearings. A one-shot lubricating system is used whereby all bearings in either unit may be lubricated simultaneously with a grease gun applied to a fitting at either end. The idler shaft and pulley assembly may be completely dismantled and reassembled without tools. Sizes range from 18 to 48 in. width.

Goulds Pumps, Inc., Seneca Falls, N. Y., has announced a new type of centrifugal stock pump for paper mill use, designed particularly for low submergence and space saving. The pump is of the vertical type with a side suction of large area leading directly to the impeller eye. Heavy anti-friction bearings are above the pump and out of the liquid. Accessibility of the rotating element is a particular feature as are the large passages and other non-clogging elements of the design.

A simple, inexpensive line of dehumidifying units known as Aqua-Sorbers has recently been put on the market by Aqua-Sorb Co., 21 South 16th St., East Orange, N. J. These devices are intended particularly for reducing high humidity in work and storage spaces. The units, which are filled with a moisture-absorbent material known as Aqua-Sorb, employ a filter bed of this material through which moist air passes, either by natural diffusion or moved by a power-operated

blower. A tank at the bottom is provided for catching drip. Humidistat control can be provided if desired. These devices range in size from 40 lb. to 100 lb. capacity of absorbent material.

Two NEW sensitive impregnated foils have recently been put on the market by the Ozalid Corp., 354 Fourth Ave., New York, N. Y. These foils may be used for duplicating old, soiled and faded tracings. Foil duplicates are made by the same method as the Ozalid whiteprints, namely, by exposing the original drawing with the sensitized foil to the light of a carbon arc or mercury vapor lamp and subjecting the print to a dry development process. The foil print intensifies the original drawing and tends to filter out undesirable background. New whiteprints can then be made from the foil at any time. One foil is clear, the other matted on one side so that pen or pencil changes can be made.

WHAT IS CLAIMED to be an extremely important development in rotor construction for squirrel cage motors is the new Copperspun rotor recently developed by Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill. So-called one-piece rotors previously in use have employed cast-in conducting elements of metals inferior to copper for this purpose, according to the manufacturer. The new process centrifugally casts the copper rotor bars and end rings as a single piece by pouring molten copper into a mold which encases the punched laminations, stacked and held under pressure. The mold is rapidly rotated during casting. Final machining and dynamic balancing of the rotor are said to give remarkably smooth operation.

MANUFACTURERS' LATEST PUBLICATIONS

Ash Handling. Allen-Sherman-Hoff Co., 225 South 15th St., Philadelphia, Pa.—Catalog 639—35-page catalog on this company's Hydrojet ash handling systems with detailed information on principles and numerous applications.

Bronze. Johnson Bronze Co., New Castle, Pa.—8-page size-and-weight listing of this company's Universal bronze bars for bearings, including broached or bored and machined bars as well as solid bars.

Chemicals. American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City—24-page booklet on properties and uses of dicyandiamide and guanidine compounds.

Electrical Equipment. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago, Ill.—Bulletin 72-D—16 pages on this company's instrument, control and auxiliary switches, portraying a wide variety of control diagrams.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-2420, 4 pages on capacitor motors to 1 hp.; GEA-2426B, 8 pages on outdoor circuit breakers; GEA-2596A, 16 pages on metal-inclosed switchgear.

Electrical Equipment. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio—Bulletin 307—6-page folder briefly describing and suggesting applications for this company's all-electric variable speed drive for alternating current circuits.

Electrical Equipment. Roller-Smith Co., 1766 West Market St., Bethlehem, Pa.—Publications as follows: Catalog 5, 12 pages on air circuit breakers; 123, 20 pages on portable instruments for alternating and direct current; Catalog 12-a, 8 pages on thermo-magnetic relays for motor, generator and transformer protection; Catalog 880, 4 pages on graphic instruments for alternating and direct current; also Catalogs 6e, f, g, dealing with indoor oil circuit breakers.

Equipment. Liberty Coppersmithing Co., 1708 North Howard St., Philadelphia, Pa.—8-page booklet illustrating and briefly describing a wide variety of process equipment fabricated by this company in clad materials, alloys and a variety of pure metals.

Equipment. Ingersoll-Rand Co., 11 Broadway, New York City—Form 1917—8-page folder detailing construction information on this company's close-coupled centrifugal pumps in capacities from 5 to 1,000 gal.; also Form 750?-J, 32 pages on Type 30 compressors and vacuum pumps in single and two-stage models with or without receivers, for belt, engine and motor drive.

Equipment. Read Machinery Co., York, Pa.—Bulletin 39304—18 pages on this company's chemical process equipment including a wide variety of mixers, blenders, and shredders, together with sifters, weigh hoppers, materials handling equipment and meters.

Equipment. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin WG-1807—20 pages describing this company's various types of water columns and gages with engineering data and information on installations; also Bulletin H-209, 4 pages describing two-, three- and four-way hydraulic valves made by this company for pressures to 5,000 lb. per sq. in.

Gaskets. Metallo Gasket Co., New Brunswick, N. J.—16-page catalog with detailed engineering information on this company's metal-asbestos, solid metal and asbestos gaskets for process and power applications.

Grinding. Raymond Pulverizer Div., Combustion Engineering Co., 1315 North Branch St., Chicago, Ill.—Bulletin 42—8-page booklet describing briefly this company's various types of grinding and combined drying and grinding equipment, as well as air separators.

Grinding. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 2103—28 pages describing a wide variety of ball and rod grinding mills made by this company with information on uses, construction, mill charges and appropriate capacities.

Heaters. The National Radiator Co., Cast Products Div., Johnstown, Pa.—Catalog CP-13—8 pages describing and giving engineering data on this company's mud leg type Oil-Rator, an alloy cast iron sectional gas-fired heating boiler for heating crude oil emulsions and for other industrial heating purposes.

Heaters. The Thermal Syndicate, Ltd., 12 East 46th St., New York City—4-page leaflet describing this company's Vitreosil electric immersion heaters for high temperature operation under corrosive conditions; also lists prices on small acid containers.

Heating and Cooling. Trenton Auto Radiator Works, Trenton, N. J.—Bulletin 100—50-page catalog and handbook on this company's wide variety of refrigeration coils, heat exchangers, condensers and unit coolers; also Bulletin H-139, 8 pages with installation details and engineering data on unit heaters.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 235—36 pages on thermocouples and accessories, covering various types; also pyrometers and resistance thermometers.

Instruments. Julien P. Fries & Sons Div., Bendix Aviation Corp., Baltimore, Md.—24-page catalog of this company's heating, refrigeration and air conditioning instruments and controls for temperature, pressure and humidity; includes valves and relays.

Power Transmission. Dawes Equipment, Inc., 2280 Penobscot Bldg., Detroit, Mich.—4-page leaflet describing construction and applications of this company's new automatic centrifugal clutch for industrial power drives.

Power Transmission. Morse Chain Co., Ithaca, N. Y.—Bulletin 75—12 pages with description, information on applications and engineering data on this company's power transmission chains, sprockets, clutches and couplings.

Power Transmission. Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind.—Booklet 860—16-page price list on this company's paper pulleys with information on how to specify.

Pumps. The Aldrich Pump Co., Allentown, Pa.—Data 65—8-page book describing in detail construction and operating principles of this company's Aldrich-Groff controllable capacity plunger pump for process charging and proportioning, boiler feed, hydraulic presses, and hydraulic-powered variable-speed applications.

Pumps. Nash Engineering Co., South Norwalk, Conn.—Bulletin 313—8-page cut-out booklet, detailing construction and advantages of the new Nash Pyrex glass centrifugal pump.

Pumps. Peerless Pump Div., Food Machinery Corp., 301 West Ave. 26, Los Angeles, Calif.—Bulletin 139-A—4-page folder describing construction of this company's water-lubricated, deep-well turbine pumps.

Refractories. General Refractory Co., Philadelphia, Pa.—New book on basic refractories with information on processes, applications, use and construction in the entire field of basic refractory service.

Rolls. The Midvale Co., Nicetown, Philadelphia, Pa.—4-page folder describing manufacture and properties of this company's forged and hardened calender rolls for paper mills.

Safety. American Optical Co., Southbridge, Mass.—New catalog on industrial safety equipment, describing in detail this company's complete line of eye, head and lung protective equipment, as well as safety clothing.

Solvents. Carbide & Carbon Chemicals Corp., 30 East 42d St., New York City—Chemical Group Folder No. 3—Leaflet describing properties and uses of eight Cellosolve solvents made by this company.

Tubes. Superior Tube Co., Norristown, Pa.—12-page book describing this company's methods of manufacturing small-diameter tubing, with information on types and applications.

V-Belts. Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., 94 Townsend St., Passaic, N. J.—Engineering data book for designers of V-belt drives, the first part covering standard drives not requiring calculation; and the second, information for designing new or special drives.

Welding. Lincoln Electric Co., Cleveland, Ohio.—Specification Bulletin 334—4-pages describing this company's 200-amp. Shield-Arc Junior belted or direct-driven welder.

Chemical Engineering NEWS

American Chemical Society Meets in Boston

The American Chemical Society is meeting at Boston, Mass., as we go to press. The group of chemists and engineers gathered together to celebrate the centenary of the discovery of the vulcanization of rubber by Charles Goodyear. Among the industrial and educational leaders who participated in the program are: P. W. Litchfield, president of Goodyear Tire and Rubber Co., "Rubber's Position in Modern Civilization"; Karl T. Campton, president of Massachusetts Institute of Technology, "Looking Forward in Research"; and James B. Conant, president of Harvard University, "Lessons From the Past".

The general meeting on Wednesday afternoon at Symphony Hall was opened by President C. A. Kraus. It was presided over by G. K. Hinshaw. The speakers at this meeting on rubber were: E. B. Babcock, Firestone Tire & Rubber Co., "What Is Vulcanization"; A. A. Glidden, Hood Rubber Co., "The Work of Thomas Hancock"; R. W. Lunn, Leyland and Birmingham Rubber Co., "The Work of Charles Goodyear"; and W. A. Gibbons, United States Rubber Co., "The Rubber Industry Since 1839".

President Kraus gave his presidential address in the ballroom of the Hotel Statler on Thursday afternoon. He spoke on "Solutions in Nonaqueous Solutions."

The local committee was headed by Conant as honorary chairman and Gustavus J. Esslen as general chairman. The other officers were: Ernest H. Huntress, general vice chairman, Frederick S. Bacon, treasurer, and Arthur R. Davis, secretary. The various committees were under the leadership of the following: J. M. Bierer, W. Fletcher Twombly, R. S. Stevens, R. C. Young, R. W. James, Kenneth E. Bell, John McGill, Grinnell Jones, Mrs. F. C. Sargent. L. F. Hamilton, L. A. Pratt, C. V. Briggs, J. J. Healy, Jr., A. A. Ashdown, W. L. Jennings, H. J. Skinner, E. O. Holmes, H. L. Sherman, H. O. Kulberg and A. A. Vernon.

Many visits to industrial plants were scheduled which showed the manufacture of diversified products of interest to chemists. Among the plants visited were: Bird & Son, Carter Ink Co., Colonial-Beacon Oil Co., Eastern Gas and Fuel Associates, Lawrence Water Works, Lever Brothers, Revere Sugar Refinery, W. F. Schrafft & Sons, Simplex Wire and Cable Co., and United Drug Co.

The usual program of technical papers were presented.

Next Census Report Will Have New Classifications

Due to the increasing importance of soybeans as an industrial product, the Bureau of the Census will set up a separate industrial classification for processors of this product in the forthcoming census of manufacturers. This is one of a number of new classifications under the general census grouping of chemicals and allied products.

For example, the manufactures census for 1939 (taken early in 1940) will break down its classification for miscellaneous oils into (1) soybean products, oil cake and meat, (2) fish and other marine oils, cake and meal, and (3) animal and vegetable oils not elsewhere classified.

Census officials declare that the growth of the plastics industry may warrant a special classification for plastic materials. Plastics are now included in "chemicals not elsewhere classified."

Another revealing change involves the establishment of a classification for mineral wool (rock, glass, slag, etc.), which was formerly classed with building insulation materials. Under the general heading of rubber products, replies from manufacturers may indicate the need of a separate classification for reclaimed rubber, which has formerly been lumped with "rubber products not elsewhere classified."

Magnesium Salts Production Planned for Cuba

A report from the commercial attache at Havana states that the Cuban Technical Tariff Commission has passed favorably upon the request made by the Cia de Productos Quimicos for the duty-free admission into Cuba of machinery for use in the precipitation of sea-water process for the manufacture of magnesium hydroxide and carbonate, calcium carbonate, and refined table salt. This proposed production is intended primarily for supplying home requirements with the possibility that later on it may become extensive enough to enter export trade.

Chemical Section of N.S.C. Schedules Two Sessions

At the 28th National Safety Congress and Exposition of the National Safety Council which will be held at Atlantic City, Oct. 16–20, two sessions have been arranged by the Chemical Section of which Ralph L. Rogers, Jr., Tennessee Eastman Corp., is general chairman, Ralph O. Keefer, Aluminum Co. of America, vice-chairman, and F. W. Dennis, Hooker Electrochemical Co., secretary. The Section will meet in the Ambassador Hotel for luncheon on Oct. 17 and in the afternoon, Mr. Rogers will open a business session at which officers for the ensuing year will be chosen. R. C. Stratton, The Travelers Insurance Co., will deliver an address and presentation of safety awards will be made. Dr. Paul V. Farragher, Aluminum Co. of America will discuss "The Selection of Safe Materials for the Design of Chemical Equipment" after which there will be a general discussion.

The second session will open on the afternoon of Oct. 19 and will consist of a panel discussion on a variety of safety problems. Speakers will include, A. L. Armstrong, Eastman Kodak Co., J. W. Dunning and H. L. Miner, E. I. duPont de Nemours & Co., C. E. Huff, Black, Sivalls & Bryson, Inc., R. S. Mackie, General Electric Co., C. E. Sevrens, Monsanto Chemical Co., John S. Shaw, Hercules Powder Co., R. C. Stratton, Travelers Insurance Co., Stanley Warzala, The Calco Chemical Co., A. L. Watson, Koppers United Co., and A. S. Zoerb, Tennessee Eastman Corp.

Industrial and public safety exhibits will be on display in the Exhibition Hall of the Auditorium.

Freeport Sulphur Promotes D. T. McIver

Announcement is made of the appointment of D. T. McIver as assistant to the president of Freeport Sulphur Co. Mr. McIver joined the company in 1923 and in 1930 was placed in charge of lands and leasing development. He has been assistant general manager in New Orleans since 1933. In his present capacity, Mr. McIver will continue as assistant general manager, dividing his time between properties in Louisiana and Texas and the head offices in New York.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

NEW government controls on business are an inevitable consequence of European conflict. The first war-period cabinet meeting adjourned with the announcement that the Attorney General had been requested to draft proposed new laws intended to restrict profiteering. This is just another way of saying that the Administration policy is going to continue to be restrictive on business, substituting Washington policy-making for business executive decisions in many matters which "affect the public interest."

Profit control is the nominal objective. Price fixing is a secondary, and almost inevitable, consequence. Administration spokesmen will deny their intention to embark on price regulation. But they will find themselves engaged in that undertaking before long, regardless of the sincerity of present protests.

Raw Material Shortages

Some shortage of materials can be expected. But little disturbance of chemical process industry is expected. It is quite clear right now what commodities are most likely to be short and what can be done about them. Common sense is needed. Any panicky buying is silly.

Those commodities which the Army and Navy Munitions Board have listed as strategic or critical are those in which important shortages should be expected first. Doubtless there are many other minor commodities normally imported that to some divisions of business are extremely important but which are not yet on this list. Those commodities will affect individual companies significantly. But they are not likely to become national problems or problems with which a very busy Uncle Sam will bother.

Washington officials are hoping that in a deliberate thoughtful manner there can be resurveys of raw material questions by each company or each industry group. But they hope that until these groups really know that they must have government help they will not all rush to Washington asking for assistance. This is not too much to hope for, it seems, since the European clash has long been anticipated and fairly good industrial reserve stocks are believed to exist for most commodities.

New Latin Markets

European supply of goods to Latin American countries will be sharply curtailed, and soon. This opens some of those markets to American firms. Resurvey of these possibilities by every merchandising unit is being suggested in Washington. It is not profiteering to pick up the customers of Latin America who no longer can depend on their customary European sources for chemicals and industrial goods supply. But Washington may call it profiteering if the price schedules now presented to prospective customers depart too widely from those which have prevailed up to recent weeks.

The trend in goods prices which will result from the military chaos of Europe causes much concern in Washington. This concern will rouse attention very promptly for any appearance of profiteering either for domestic or foreign trade. It will encourage price increases only with respect to those agricultural raw materials which have been in surplus, especially those commodities which have been the political cause of much agricultural relief. It is going to be quite necessary to watch up-trends of prices on other classes of goods, or official investigators are likely to rap at the front door to attend to this matter for industry.

News "Fines"

Tariff Cuts—Some of the trade agreement negotiation planned by Secretary Hull is, of course, now out of the question, negotiation with Belgium for example. But there is every reason to believe that the State Department will be anxious to press vigorously negotiations with Argentina and perhaps renew discussions with Venezuela and accelerate the supplemental Cuban agreement. Several byproducts of agricultural industry, such as oleo oil, tallow, crude glycerine, vegetable oils, and a few fertilizer raw materials, are to be discussed with the Argentine negotiators. The full list of commodities under consideration was published by Secretary Hull in an official promulgation of August 26.

Fertilizer Wages—Minimum wages in the fertilizer industry were fixed by Secretary of Labor Perkins and are now governing (since September 12) manufacturing by companies supplying goods on contracts to the government. Four geographic areas were recognized and the minimum prevailing wages found for these were 25 cents, 30 cents, 40 cents, and 50 cents per hour. This wide spread in minimums about corresponds to prevailing rates in the industry, and is likely to stir the fertilizer man to very little criticism.

War Taxes—New taxes for war purposes seem unlikely unless the United States should become involved in hostilities. Members of Congress know that the present federal tax law will raise a stupendous sum of money if there should be, as now rather expected, a substantial increase in the volume and dollar value of business transactions of the country. A near-boom year might actually balance the budget, careful analysts believe.

Wood Pulp Inquiry—The United States Tariff Commission has announced an inquiry on wood pulp and pulpwood to determine the relationship of imported and domestic production, prices, and trade factors. This is a fact-finding, not a witch-hunting, expedition, the result of a definite Senate resolution adopted August 1. It will give the industry an opportunity to tell its international trade troubles, as well as rattle a few skeletons usually in the closet.

New Food Standards—Food and Drug Administration is now promulgating at short intervals new standards of identity for manufactured foods. Some of these are very important to chemical process industry as they determine the conditions under which commodities may be utilized in foods, either as normal constituents or as "optional ingredients" which must be declared on the label. The trend of the Department findings thus far is to give some freedom of choice to food manufacturers in the use of new or unusual components; but generally the less usual components must be declared on the label. This has aroused some criticism on the ground that it discourages improvements in food formulas by making the new goods appear to be inferior because the composition has to be stated on the label. The corn sugar-cane sugar battle which has been most conspicuous is not by any means the only one that has caused some difficulty, and considerable delay, in these cases.

Tighter Wage-Hour Rules—Effective October 24, the Fair Labor Standards Act provides that 30 cents an hour shall be the minimum wage and any time over 42 hours per week is overtime requiring pay and a half. This intensifies the effort of industries seeking exemptions under one or another phase of the law. It will aggravate the controversy before Congress when it reconvenes and may speed up some reasonable amendments to the law.

War-Time Strikes—Washington really expects more strikes in the next few months than have been encountered during the past year. War demands for goods give an excellent basis for labor leaders' claims for new concessions to labor. Those who recall the labor problems of 1917 and 1918 do not expect that any second-hand patriotism will have any

influence in preventing the most aggressive effort by union organizers. They were not deterred during the World War when Uncle Sam was a participant. They are not likely to be slowed down at all now.

Many New Products Will Be on Display at Chemical Show

More than forty industries producing materials and equipment will display their latest products at the Seventeenth Exposition of Chemical Industries for which nearly 300 exhibitors have already engaged space to occupy three floors of Grand Central Palace, New York. The exposition, now marking its 25th year of service to the chemical industries, will be held during the week beginning Dec. 4.

Chemicals and chemical raw materials constitute an important section of the Exposition and many of this year's exhibits will be significant in showing the effects of American research methods continuously applied. One exhibitor will feature hydroxylamine hydrochloride assaying 98 per cent and better. This type of chemical is representative of a group which in the past has been largely imported or difficult to find in the American market. Other reagent chemicals shown will include amorphous boron, boron nitride, phenylhydrazine hydrochloride, dimethyl glyoxime, hydroxylamine sulphate, semicarbizide hydrochloride, phenylmethyl pyrazalone, butyl bromide, hydrazine sulphate. Additional reagent chemicals will include those in liquid and gaseous form. A total of 29 gases will be demonstrated by one exhibitor, also cylinders, valves, gages, and controls for handling them in the laboratory.

Glycerine as a basic chemical raw material will be exhibited in terms of its many applications in the manufacture of foods, cosmetics, pharmaceuticals, textiles, rubber, leather goods, and plastics.

Diatomaceous earth products will be shown as filter aids and as raw materials used as fillers and extenders in the manufacture of paper, rubber, plastics, oil and water paints, and varnishes and many other products.

Containers and packaging machinery, always an important classification of the Chemical Exposition, will be unusually well represented this year. A new type ampoule-sealing machine will demonstrate its ability to handle with accuracy any of the numerous types of solutions which are dispensed in ampoule form. Notable among the packaging equipment on display will be a low-priced cellophane bag-making machine. This unit is guaranteed to manufacture bags out of cellophane or similar materials in any size, single or double wall, printed or plain; also a volumetric filler representing a recent accomplishment in flexibility and simplification in this field of machine design.

Plant equipment designed for all unit processes of chemical engineering will constitute a large section of the exposition. The art of controlling the flow of bulk material by vibration will be demonstrated by equipment. This display will include electro-magnetic vibrators, vibratory feeder conveyors, volumetric feeder machines, and weigh feeder machine equipment. A counter current rapid batch mixer will feature a modern mechanical method for scientifically blending, mixing, and compounding difficult formulas of dry, damp, or slurry consistencies.

Filtration will be demonstrated by many operating models. One filter offers a unique method for building a filter medium or "precoat" and discharging the cake. One filter manufacturer will feature continuous rotary models, also plate pressure units. Related to filtration and the chemical engineering processes having to do with the flow of fluids will be the operating exhibits of pumps of many kinds which are scheduled to be shown at the exposition.

Chandler Medal Awarded to Thomas H. Chilton

The seventeenth Charles Frederick Chandler Medal of Columbia University has been awarded to Thomas H. Chilton, director of the technical division of the engineering department of E. I. duPont de Nemours & Co., Wilmington, Del. The honor was conferred on Mr. Chilton for his outstanding achievements in the discovery and formulation of principles underlying the unit operations of chemical engineering, and in application of these principles to process development, equipment design, and chemical plant construction and operation. The medal will be presented to Mr. Chilton on Nov. 16 at which time he will deliver the annual Chandler Lecture on "Engineering in the Service of Chemistry."

Union Carbide Acquires All Assets of Bakelite Corp.

At a meeting held Aug. 29, the board of directors of the Union Carbide and Carbon Corp. approved an agreement for the acquisition of all the assets of the Bakelite Corp. The coordination of technical knowledge, research, production methods, and distribution facilities will bring valuable supplementary facilities to both organizations. Under the agreement there will be distributed to Bakelite stockholders 187,500 shares of Carbide common stock exchanged for Bakelite's assets. Bakelite preferred stockholders will be entitled to receive for each preferred share one and one-quarter shares of Carbide stock, the remainder of the Carbide stock to be divided ratably among the Bakelite common stockholders. The agreement will become effective upon ratification by the holders of each class of Bakelite stock.

New Oil Refining Course at Brooklyn Poly

A new graduate course in petroleum refining is offered at the Polytechnic Institute, Brooklyn. This course will cover chemical engineering processes and equipment used in the petroleum industry; the refining of crude petroleum and production of gasoline, kerosene, lubricating oils, fuel oils, and other materials. Modern methods of distillation, cracking, hydrogenation, and refining by solvents will be studied as well as the theory, design, construction, and operation of separating units, cracking units, and other equipment. The processes and operations for producing solvents and other materials that have chemical utility as well as polymer gasolene will also be covered. The production, transportation, and storage of petroleum and its products will be discussed. Costs of production will be analyzed.

A group of leading technical men in the petroleum field have been engaged to discuss the various processes in which they have specialized.

Under the general direction of Prof. J. C. Olsen the following lecturers will participate in giving the course: Drs. P. K. Frolich, E. B. Peck, M. R. Mandelbaum, Gustav Egloff, B. T. Brooks, C. W. Rippie and Messrs. P. J. Gaylor, D. E. Larson, N. F. MacCoull, B. Y. McCarty, R. R. Thurston, E. W. Howard, representing the Standard Oil Development Co., Universal Oil Products Co., Gray Processes Corp., Solvay Sales Corp., Chicago Bridge & Iron Co., The Texas Co., and the M. W. Kellogg Co.

The course will consist of thirty lectures, beginning Wednesday evening, Sept. 27.

Monsanto Chemical Co. Wins Massachusetts Safety Award

The Merrimac Division of the Monsanto Chemical Co. was given the Massachusetts Safety Council's banner for the best safety record in the most hazardous classification for the second quarter of this year. Merrimac's record for the quarter was 401,839 man-hours and has been extended through July to a total of approximately 925,000 man-hours since the last lost-time injury. Merrimac also won the banner for the first quarter of 1937.

W. F. Allen Will Head Research At Herty Laboratory

Named as acting technical director, William F. Allen will supervise research work at the Herty Foundation Laboratory, Savannah, Ga. This appointment was made to fill the vacancy created by the resignation of the former director, Charles H. Carpenter who is now associated with the Southland Paper Mills, Inc., Lufkin, Texas.

Chemical ECONOMICS and MARKETS

CONSUMPTION OF CHEMICALS MOVING UP SHARPLY IN THE CURRENT MONTH

DEMAND for chemicals has been on an ascending scale in recent weeks and has been greatly accelerated since the turn of the month. In some cases this a reflection of increased operations at consuming plants but it is possible that some of the activity may have resulted because of a desire on the part of some buyers to accumulate stocks as a precautionary measure. Complete figures for activities in August are not yet available but from the data at hand and from trade estimates, consuming industries had responded to the stimulus of improvement in general business. For instance, the index of the Federal Reserve Board for August moved up to 102 from 97 in the preceding month.

The preliminary index for consumption of chemicals for August was approximately 116 which represents a marked gain over the revised index of 111.08 for July. Final figures for July proved disappointing and brought about a sharp downward revision of the preliminary figure. Index numbers for July and August last year were 92.66 and 104.66 respectively. The August total this year was aided by higher operating schedules at steel mills, oil refineries, and chemical plants.

Chem. & Met. Index for Consumption of Chemicals

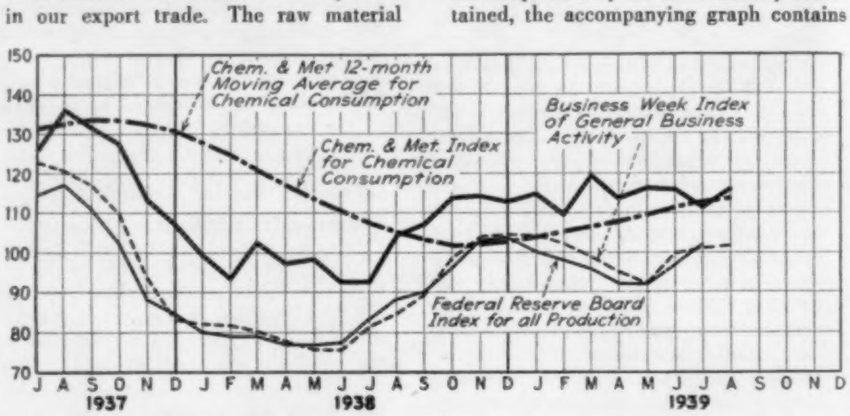
	June Revised	July
Fertilizer	20.04	19.80
Pulp and paper	14.94	14.35
Glass	13.08	12.59
Petroleum refining	13.62	13.86
Paint and varnish	12.40	9.59
Iron and steel	6.60	6.56
Rayon	8.06	8.44
Textiles	8.48	7.10
Coal products	6.31	6.93
Leather, glue and gelatine	3.88	4.12
Explosives	4.40	4.04
Rubber	2.70	2.41
Plastics	1.84	1.86
	116.35	111.65

In the current month, improvement has been reported at automotive plants, rayon mills—one plant resumed work after a cessation of a month due to labor troubles—textile mills and glass works. Plastics also are being produced in a larger way particularly in some divisions of this industry.

The international situation has the dual effect of closing sources of supply for certain raw materials and of excluding some markets which have been important in our export trade. The raw material situation, however, is not serious and the finished products imported have been largely competitive and their curtailment should work in favor of home products. Export trade faces the probability of loss in some directions with a more than compensating gain in the development of new markets where foreign competition will be lessened.

Reverting to the state of business in July, The Department of Commerce reports that sales of manufacturers were 12.8 per cent above those for July 1938 and 7.6 per cent below the figures for June. Comparison of sales in terms of percentage, for July with July 1938 and with June 1939 include: textiles, up 8.7 and down 0.8; paper, up 25.6 and down 10.6; chemicals and allied products, up 10.1 and down 12.8; paint and varnish, up 10.1 and down 12.8; other chemical products, up 10.3 and down 8.6. In practically all lines sales were lower in July than they were in the preceding month which is customary for July trading.

The index for consumption of chemicals does not take into account seasonal factors as it is intended primarily as a measure for the flow of chemicals from month to month in terms of actual quantities consumed. In order that the trend of consumption may be more readily ascertained, the accompanying graph contains a twelve-month moving average which points out the direction in which consumption is headed. In this index the average for the twelve months preceding is shown with its continuance resulting from the substitution of the index for the current month for that of the corresponding month of the preceding year. It is essentially a trend index and is not affected by seasonal influences or other factors which make adjustments necessary to show trends.



Production and Consumption Data for Chemical-Consuming Industries

Production	July 1939	July 1938	January–July 1939	January–July 1938	Per cent of gain for 1939
Alcohol, ethyl, 1,000 pr. gal	17,643	16,370	120,145	110,536	8.7
Alcohol denatured, 1,000 wi. gal	6,937	6,725	52,210	44,151	18.3
Ammonia liquor, 1,000 lb	4,268	3,016	28,553	23,768	20.1
Automobiles, sales, no	209,343	141,443	2,171,256	1,345,336	61.4
Benzol, 1,000 gal	8,028	4,769	50,581	37,200	36.0
Byproduct coke, 1,000 tons	3,365	2,177	21,649	16,894	28.1
Glass containers, 1,000 gr	4,581	3,506	28,937	24,330	18.9
Plate glass, 1,000 sq. ft	6,212	5,506	65,046	30,733	111.7
Cellulose acetate plastics, 1,000 lb	561	658	4,968	2,303	115.8
Nitrocellulose plastics, 1,000 lb	979	634	7,376	4,680	57.6
Rubber reclaimed, tons	12,588	7,682	99,139	50,249	97.3
Consumption					
Cotton, bales	521,405	448,453	4,055,429	3,103,556	30.7
Silk, bales	26,142	32,593	218,248	222,012	1.7*
Wool, 1,000 lb	35,473	27,742	217,274	125,657	72.9
Explosives, 1,000 lb	27,652	23,316	197,168	172,412	14.4
Rubber, crude, tons	43,880	34,219	318,446	209,280	52.2
Waste paper, tons	255,830	221,218	1,816,587	1,536,744	18.2

* Per cent of decline

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.06 -$0.06½	$0.05½-$0.06½	$0.05½-$0.06½
Acid, acetic, 28%, bbl., cwt.	2.23 - 2.48	2.23 - 2.48	2.23 - 2.48
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.25 -10.50
Boric, bbl., ton	106.00-111.00	106.00-111.00	106.00-111.00
Citric, kegs, lb.	.20 - .23	.20 - .23	.23½- .26
Formic, bbl., ton	.10½- .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb.	.70 - .75	.70 - .75	.70 - .75
Hydrofluoric 30% carb., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriatic, 18°, tanks, cwt.	1.05 -......	1.05 -......	1.05 -......
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb.	.10½- .12	.10½- .12	.10½- .12
Phosphoric, tech., c'bys., lb.	.07½- .08½	.07½- .08½	.09 - .10
Sulphuric, 60° tanks, ton	13.00 -......	13.00 -......	13.00 -......
Sulphuric, 66°, tanks, ton	16.50 -......	16.50 -......	16.50 -......
Tannic, tech., bbl., lb.	.40 - .45	.40 - .45	.40 - .45
Tartaric, powd., bbl., lb.	.29½-......	.27½-......	.27½-......
Tungstic, bbl., lb.	2.35 -......	2.35 -......	2.75 -......
Alcohol, Amyl	...-......	...-......	...-......
From Pentane, tanks, lb.	.101-......	.101-......	.106-......
Alcohol, Butyl, tanks, lb.	.07 -......	.07 -......	.08½-......
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.54 -......	4.54 -......	4.58½-......
Denatured, 190 proof			
No. 1 special, bbl., gal. wks.	.26½-......	.26½-......	.29 -......
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Potash, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Aluminum sulphate, com. bags, cwt.	1.15 - 1.40	1.15 - 1.40	1.15 - 1.40
Iron free, bg., cwt.	1.30 - 1.55	1.30 - 1.55	1.30 - 1.55
Aqua ammonia, 26°, drums, lb.	.02 - .03	.02 - .03	.02½- .03
tanks, lb.	.02 - .02¾	.02 - .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½-......	.15½-......	.15½-.16
tanks, lb.	.04½-......	.04½-......	.04½-.16
Ammonium carbonate, powd. tech., casks, lb.	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks, cwt.	1.40 -......	1.35 -......	1.325-......
Amylacetate tech., tanks, lb.	.09½-......	.09½-......	.11 -......
Antimony Oxide, bbl., lb.	.11 - .12	.10 - .11	.11½- .12
Arsenic, white, powd., bbl., lb.	.03 - .03½	.03 - .03½	.03 - .03½
Red, powd., kegs, lb.	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	52.50 -57.50
Chloride, bbl., ton	79.00 -81.00	79.00 -81.00	79.00 -81.00
Nitrate, casks, lb.	.07 - .08	.07 - .08	.07 - .08
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	48.00 -51.00	48.00 -51.00	48.00 -51.00
Bromine, cs., lb.	.30 - .32	.30 - .32	.30 - .32
Calcium acetate, bags	1.65 -......	1.65 -......	1.65 -......
Arsenate, dr., lb.	.06½- .07	.06½- .07	.06½- .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton	21.50 -24.50	21.50 -24.50	21.50 -24.50
flake, dr., del., ton	23.00 -25.00	23.00 -25.00	23.00 -25.00
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.04¾- .05½	.04¾- .05½	.05½- .06
Chlorine, liquid, tanks, wks., lb.	1.75 -......	1.75 -......	2.15 -......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb.	1.67 - 1.70	1.67 - 1.70	1.67 - 1.70
Copperas, bgs., f. o. b., wks., ton.	15.00 -16.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb.	.10 - .16½	.10 - .16½	.09 - .16
Sulphate, bbl., cwt.	4.60 - 4.85	4.25 - 4.50	4.25 - 4.50
Cream of tartar, bbl., lb.	.24½- .25	.22½- .23	.22½- .23
Diethylene glycol, dr., lb.	.22 - .23	.22 - .23	.22 - .23
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb.	.061-......	.061-......	.06½-......
Formaldehyde, 40%, bbl., lb.	.05¾- .06½	.05¾- .06½	.05¾- .6½
Furfural, tar ks. lb.	.09 -......	.09 -......	.09 -......
Fusel oil, ref. drums, lb.	.12½- .14	.12½- .14	.12½- .14
Glaubers salt, bags, cwt.	.95 - 1.00	.95 - 1.00	.95 - 1.00
Glycerine, c.p., drums, extra, lb.	.12½-......	.12½-......	.16½-......
Lead:			
White, basic carbonate, dry casks, lb.	.07 -......	.07 -......	.06¾-......
White, basic sulphate, sck., lb.	.06½-......	.06½-......	.06¾-......
Red, dry, sck., lb.	.08 -......	.076-......	.074-......
Lead acetate, white crys., bbl., lb.	.10½- .11	.10 - .11	.10 - .11
Lead arsenate, powd., bbl., lb.	.10 - .10½	.10 - .10½	.12½- .13
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk., lb.	.0685-......	.0635-......	.064-......
Lithophone, bags, lb.	.04 - .04½	.04 - .04½	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Sept. 14

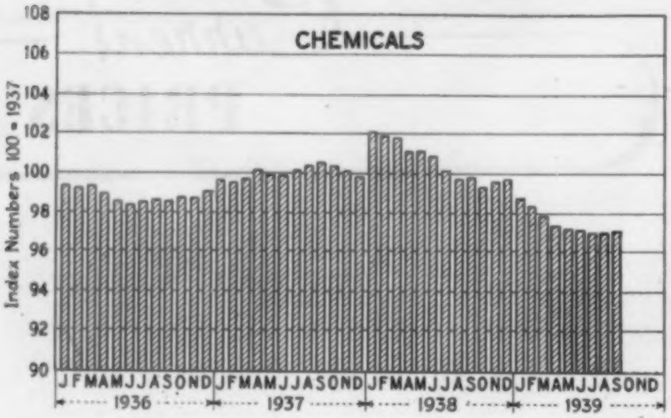
Current PRICES

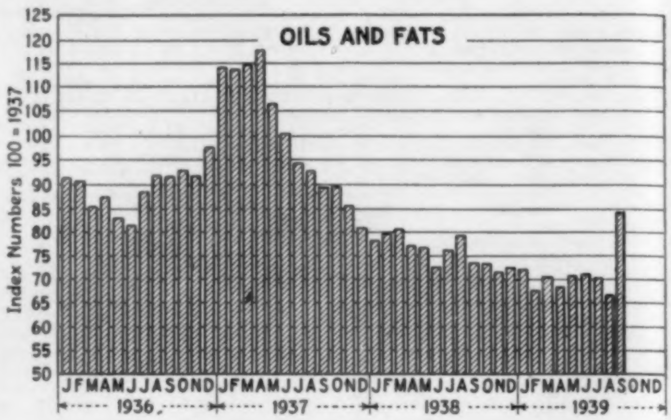
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31 -......	.31 -......	.31 -......
97%, tanks, gal.	.32 -......	.32 -......	.32 -......
Synthetic, tanks, gal.	.33 -......	.33 -......	.33 -......
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb.	.10¼-......	.10¼-......	.10¼-......
Phosphorus, red, cases, lb.	.40 - .42	.40 - .42	.40 - .42
Yellow, cases, lb.	.18 - .25	.18 - .25	.24 - .30
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.08½- .09
Carbonate, 80-85%, calc. csk., lb.	.06½- .07	.06½- .07	.06½- .07
Chlorate, powd., lb.	.09½-......	.09½-......	.09½-......
Hydroxide (c'stic potash) dr., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., unit.	.53½-......	.53½-......	.53½-......
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.18½- .19
Prussate, yellow, caks, lb.	.14 - .15	.14 - .15	.15 - .16
Sal ammoniac, white, casks, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Satsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.05 -......	1.05 -......	1.05 -......
Dense, bags, cwt.	1.10 -......	1.10 -......	1.10 -......
Soda, caustic, 76%, solid, drums, cwt.	2.30 - 3.00	2.30 - 3.00	2.30 - 3.00
Acetate, works, bbl., lb.	.04 - .05	.04 - .05	.04½- .05
Bicarbonate, bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Bichromate, casks, lb.	.06¾- .07	.06¾- .07	.06¾- .07
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.06½- .06½	.06½- .06½	.06½- .06½
Cyanide, cases, dom., lb.	.14 - .15	.14 - .15	.14 - .15
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	2.20 - 3.20	2.20 - 3.20	2.15 - 3.15
Nitrate, bulk, cwt.	1.35 -......	1.35 -......	1.45 -......
Nitrite, casks, lb.	.06½- .07	.06½- .07	.07 - .08
Phosphate, dibasic, bags, lb.	1.85 -......	1.85 -......	1.85 - .024
Prussiate, yel. drums, lb.	.09½- .10	.09½- .10	.09½- .10
Silicate (40° dr.) wks., cwt.	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, crys., bbl., lb.	.02½- .02¾	.02½- .02½	.02½- .02½
Sulphur, crude at mine, bulk, ton.	16.00 -......	16.00 -......	18.00 -......
Chloride, dr., lb.	.03 - .04	.03 - .04	.03 - .04
Dioxide, cyl., lb.	.07 - .08	.07 - .08	.07 - .07½
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb.	.54 -......	.52 -......	.48 -......
Crystals, bbl., lb.	.50½-......	.38 -......	.35 -......
Zinc, chloride, gran., bbl., lb.	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb.	.14 - .15	.14 - .15	.14 - .15
Cyanide, dr., lb.	.33 - .35	.33 - .35	.33 - .35
Dust, bbl., lb.	.08 -......	.06½-......	.06½-......
Zinc oxide, lead free, bag., lb.	.06½-......	.06½-......	.06½-......
5% lead sulphate, bags, lb.	.06½-......	.06½-......	.06½-......
Sulphate, bbl., cwt.	2.75 - 3.00	2.75 - 3.00	3.15 - 3.60

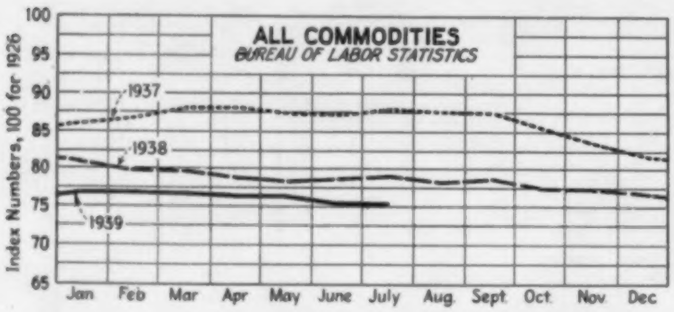
OILS AND FATS

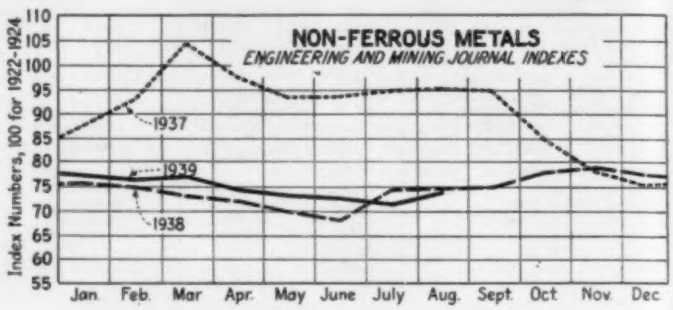
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb.	$0.08½-$0.10	$0.08½-$0.10	$0.09½-$0.10
Chinawood oil, bbl., lb.	.27 -......	.22 -......	.13 -......
Coconut oil, Ceylon, tank, N. Y., lb.	.04½-......	.02¾-......	.03½-......
Corn oil crude, tanks (f. o. b. mill), lb.	.07 -......	.05 -......	.07 -......
Cottonseed oil, crude (f. o. b. mill), tanks, lb.	.06½-......	.04½-......	.06½-......
Linseed oil, raw car lots, bbl., lb.	.095-......	.087-......	.081-......
Palm, casks, lb.	.04½-......	.03½-......	.03½-......
Peanut oil, crude, tanks (mill), lb.	.07 -......	.05½-......	.07½-......
Rapeseed oil, refined, bbl., gal.	.90 -......	.80 -......	.75 -......
Soya bean, tank, lb.	.06 -......	.04½-......	.05½-......
Sulphur (olive foots), bbl., lb.	.08 -......	.06¾-......	.07½-......
Cod, Newfoundland, bbl., gal.	.32 -......	.32 -......	.38 -......
Menhaden, light pressed, bbl., lb.	.068-......	.056-......	.067-......
Crude, tanks (f. o. b. factory), gal.	.30 -......	.24 -......	.30 -......
Grease, yellow, loose, lb.	.05½-......	.04 -......	.04½-......
Oleo stearine, lb.	.09 -......	.05½-......	.07½-......
Oleo oil, No. 1	.07½-......	.06½-......	.09½-......
Red oil, distilled, d.p. bbl., lb.	.07½-......	.07½-......	.08½-......
Tallow extra, loose, lb.	.06 -......	.04½-......	.05½-......

Chem. & Met.'s Weighted Price Indexes









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 -$0.55	$0.52 -$0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb	.23 - .25	.23 - .25	.25 - .27
Benzol, 90%, tanks, works, gal	.16 - .18	.16 - .18	.16 - .18
Beta-napthol, tech., drums, lb	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb	.09½- .10	.09½- .10	.10½- .11
Cresylic acid, dr., wks., gal	.55 - .57	.55 - .57	.78 - .80
Diethylaniline, dr., lb	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluen, bbl., lb	.15 - .16	.15 - .16	.15 - .16
Dip oil, 15%, dr., gal	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb	.32 - .36	.32 - .36	.32 - .36
H-acid, bbl., lb	.50 - .55	.50 - .55	.50 - .55
Naphthalene, flake, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Nitrobenzene, dr., lb	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb	.47 - .49	.47 - .49	.50 - .52
Phenol, U.S.P., drums, lb	.13 -......	.13 -......	.14½-......
Picric acid, bbl., lb	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal	1.55 - 1.60	1.55 - 1.60	1.55 - 1.60
Resorcinal, tech., kegs, lb	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal	.26 -......	.26 -......	.27 -......
Tolidine, bbl., lb	.86 - .88	.86 - .88	.88 - .90
Toluene, tanks, works, gal	.27 -......	.27 -......	.27 -......
Xylene, com, tanks, gal	.26 -......	.26 -......	.26 -......

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb	.14 - .15½	.11½- .12	.10 - .11
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb	.02¼- .30	.02¼- .30	.02¼- .30
Prussian blue, bbl., lb	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb	.10 - .26	.10 - .26	.10 - .26
Chrome green, bbl., lb	.21 - .30	.21 - .30	.21 - .27
Carmine red, tins, lb	4.35 - 4.40	4.35 - 4.40	4.00 - 4.40
Para toner, lb	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb	2.40 - 2.50	1.57 - 1.58	1.45 - 1.50
Chrome yellow, C.P., bbl., lb	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb	.06 - .06½	.06 - .06½	.06 - .06½
Gum copal Congo, bags, lb	.07 - .30	.06 - .30	.06 - .30
Manila, bags, lb	.08 - .15	.07 - .14	.09 - .14
Damar, Batavia, cases, lb	.08 - .20	.07½- .20	.08 - .24
Kauri cases, lb	.18 - .60	.17½- .60	.18½- .60
Kieselguhr (f.o.b. N. Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -......	50.00 -......	50.00 -......
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .04	.03 - .04	.03 - .04
Rosin, H., bbl	6.95 -......	6.45 -......	5.35 -......
Turpentine, gal	.31½-......	.29½-......	.27½-......
Shellac, orange, fine, bags, lb	.22 -......	.19 -......	.20 -......
Bleached, bonedry, bags, lb	.21 -......	.18 -......	.18 -......
T. N. Bags, lb	.14 -......	.09½-......	.11 -......
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -......	13.75 -......	13.75 -......

INDUSTRIAL NOTES

HOOKER ELECTROCHEMICAL CO. has transferred its administrative, sales, and accounting headquarters from New York to Niagara Falls. A local office is maintained at 60 East 42d St., New York.

PITTSBURGH EQUITABLE METER CO., Pittsburgh, has appointed the Anthony Bruyaux Co., Brussels, as sales agents in Belgium, Holland and France.

INDUSTRIAL INSTRUMENTS, INC., Bayonne, N. J. has moved its plant and offices to 156 Culver Ave., Jersey City. The company has organized a special equipment division to manufacture custom built electrical test equipment.

WESTVACO CHLORINE PRODUCTS CORP., New York, is housing its subsidiaries, The Warner Chemical Co. and California Chemical Co. in new offices at 405 Lexington Ave., New York.

BLAW-KNOX CO., Pittsburgh, has appointed S. J. Horrell sales manager for the power piping division.

V. D. ANDERSON CO., Cleveland, has moved into its new office building at 1935 West 96th St.

AMERICAN POTASH & CHEMICAL CO., New York has closed its office in Baltimore. E. M. Kolb, manager of the former Baltimore office is now located at the main office.

VIRGINIA-CAROLINA CHEMICAL CO., Richmond, has placed M. E. Hunter in charge of the sales office at Montgomery. A. N. Myers will succeed Mr. Hunter at the Columbia office.

NATIONAL ADHESIVES CORP., New York has changed its corporate title to that of National Starch Products, Inc.

COLUMBIA ALKALI CO., Barberton, Ohio, has moved its sales offices back to 30 Rockefeller Plaza, New York. W. I. Galliher and J. P. Leppart are in charge.

New CONSTRUCTION

	Current Projects		Cumulative 1939	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	....	$1,335,000	$1,400,000
Middle Atlantic	$115,000	$1,345,000	4,965,000	13,042,000
South	....	40,000	8,733,000	10,195,000
Middle West	2,100,000	140,000	15,625,000	13,665,000
West of Mississippi	845,000	16,807,000	6,310,000	8,896,000
Far West	....	1,591,000	2,270,000	1,992,000
Canada	100,000	....	8,960,000	5,055,000
Total	$3,160,000	$19,923,000	$48,198,000	$54,245,000

PROPOSED WORK

Chemical Plant—American Ferment Co., 165 Adams St., Buffalo, N. Y., plans to construct an addition to its plant. Estimated cost will exceed $40,000.

Chemical Plant — Monsanto Chemical Co., Edgar M. Queeny, Pres., 1700 South Second St., St. Louis, Mo., plans to enlarge its chemical plant to include a new diphenyl unit, at Anniston, Ala. Estimated cost $75,000.

Distillery—American Distillery Co., Inc., 405 Lexington Ave., New York, N. Y., has purchased a site at St. Catherines, Ont., Can., and plans to construct a distillery. Estimated cost $100,000.

Lead Factory—National Lead Co., 111 Bway., New York, N. Y., plans to alter its 2 story, 69x161 ft. factory on Marshall St., Brooklyn, N. Y. W. Higginson & Son, 101 Park Ave., New York City, Archt. Estimated cost $50,000.

Natural Gas Development — Fred L. Dougherty & Co., Central Ave., Dunkirk, N. Y., plans extensive development of natural gas area in Stockton and Pomfret Townships, Chautauqua Co., near Cassadaga, including drilling unspecified number of 4000 ft. wells, each requiring 2000 ft. or more of 6½ in. pipe, also connecting pipe lines, etc. Bids will soon be taken on pipe requirements. Estimated cost will exceed $25,000.

Gas Recycling Plant—Tidewater Associated Seaboard Oil Co., Palestine, Tex., will soon award the contract for the construction of a second plant in the Cayuga field near Palestine. Estimated cost $100,000.

Oil Refinery—B. W. Fitzgerald, 5905 Arsenal St., St. Louis, Mo., plans to construct a refinery to include one 420,000 gal. fuel tank, one 210,000 gal. crude oil tank and three 21,000 gal. naptha tanks, etc., on a two acre tract bordered by Primm, Tesson, Van Buren and Polk Sts., St. Louis.

Gas Pumping Stations—Magnolia Pipe Line Co., Longview and Beaumont, Tex., plans to construct two Butane gas pumping stations at Kilgore and Francis, Tex. Estimated cost $70,000.

Oxygen Plant—Independent Oxygen Co., c/o L. E. Sherman, 1807 Dallas Ave., North College Hill, Cincinnati, O., plans to construct an oxygen plant. Estimated cost $100,000.

Rubber Factory—Goodyear Tire & Rubber Co., 1144 East Market St., Akron, O., plans to construct a 2 or 3 story plant on South Wayne St., St. Marys, O., for the manufacture of novelty rubber goods. H. S. Schmidt is in charge of construction for the Company. Estimated cost including equipment $2,000,000.

Smelting Plant — A. S. Bergendahl, Bankers Mortgage Bldg., Houston, Tex., plans to construct an iron smelting plant on the ship channel at Houston. Estimated cost $500,000.

CONTRACTS AWARDED

Cement Plant—Permante Corp., P. O. Box 29, San Jose, structural steel for Sugar Rock Plant, at Cupertino, Calif., to Judson-Pacific Co., 609 Mission St., San Francisco***structural steel for Klinker storage, to Bethlehem Steel Co., 20 and Illinois Sts., San Francisco ***railroad, to A. D. Schader, 144 Spear St., San Francisco***furnishing kiln motors, panel boards and switchboards, to Westinghouse Electric Co., 1st Natl. Bank Bldg., San Francisco ***rock crushers, to Kennedy Van Saun & Taylor Eng. Co.,*** cement silos and reclaiming tunnels and 225 ft. chimney, to Rust Eng. Co., 941 16 St., San Francisco***concrete work for picking plant and kiln fdns., to Eaton & Smith, 715 Ocean Ave., San Francisco***excavation for cement rock storage and reclaiming tunnels, to Frederickson Bros., 1259 65 St., Emeryville***2,300 k.v. power line to quarry, to Eureka Electric Co., 3469 Mission St., San Francisco***concrete work, clinker storage, slurry tanks, to E. W. Heple, 494 Delmas Ave., San Francisco***pipe line construction, to Underground Constr. Co., 354 Hobart St., Oakland***steel slurry tanks, to Independent Iron Wks., 18 and Campbell Sts., Oakland***concrete work for mill buildings, 2 reclaim tunnels, headwalks, steel superstructure for Cottrell House, to Moore Drydock Co., foot of Adeline St., Oakland. Total est. cost $1,000,000.

Distillery — Georgia Growers Distilling Co., c/o A. Thomas Bradbury, William Oliver Bldg., Atlanta, Ga., has awarded the contract for a distillery at Albany, Ga., to M. L. Spratlin, 990 Greenwood Ave., Atlanta. Estimated cost $40,000.

Factory—Electro Refractories & Alloys Corp., Andrews Bldg., Buffalo, N. Y., has awarded the contract for a 1 story, 50x100 ft. plant addition to Crea Construction Co., Wallace Ave., Buffalo.

Factory — Pyrene Manufacturing Co., Inc., 560 Belmont Ave., Newark, N. J., has awarded the contract for a 1 and 2 story, 130x190 ft. factory to Wigton-Abbott Corp., 1225 South Ave., Plainfield, N. J. Estimated cost $100,000.

Gas Pipe Line—Magnolia Pipe Line Co., Longview and Beaumont, Tex., has awarded the contract for 8 to 10 in. Butane gas pipe line between Francis and Beaumont, to Sheehan Pipe Line Construction Co., National Bank of Tulsa Bldg., Tulsa, Okla., at $116,000; between Longview and Beaumont to T. R. Jones, Inc., Magnolia St., Dallas. Estimated cost $141,000.

Gas Pipe Line—Northern Natural Gas Co., Aquila Court, Omaha, Neb., has awarded contract for constructing east section of 240 mi. of 16 in. pipe line from Sioux City, Ia., to point near Minneapolis, Minn., to Truman-Smith Construction Co.; west section to C. L. Foreman, both of Kansas City, Mo.; furnishing 27,000 tons 16 in. steel pipe to National Tube Co., Frick Bldg., Pittsburgh, Pa., to Republic Steel Co., 335 Market St., Youngstown, O., and Youngstown Sheet & Tube Co., Stambaugh Bldg., Youngstown. Total estimated cost $15,000,000.

Gas Pipe Line—Standard Oil Co. of Indiana, Philcade Bldg., Tulsa, Okla., has awarded the contract for 167 mi. 8 in. gas pipe line from Sugar Creek, Mo., and Council Bluffs, Ia., to Gordon Construction Co., 31st and Platte Sts., Denver, Colo., Fredell Construction Co., Fannin Bldg., Houston, Tex., Bibb Contg. Co., Valley Park, Mo., and Sheehan Pipe Line Construction Co., National Bank of Tulsa Bldg., Tulsa, Okla. Estimated cost $350,000.

Gas Recycling Plant—Davis & Co., Inc., Houston and Corpus Christi, Tex., will construct a recycling and natural gasoline plant in the Alice fields of Jim Wells Co., Alice, Tex. Work will be done by owners. Estimated cost $500,000.

Laboratory—G. F. Harvey Co., Saratoga Springs, N. Y., has awarded the contract for a laboratory building to Wm. J. Murray Construction Co., Inc., 41 South Pearl St., Albany, N. Y. Estimated cost $45,000.

Oil Refinery—Barnsdall Oil Refining Co., Corpus Christi, Tex., is building a new skimming unit at its plant. Work will be done by owner's forces. Estimated cost $125,000.

Oil Refinery — National Oil Products Co., Essex St. and Passaic River, Harrison, N. J., has awarded the contract for a factory and storage building to Mahoney-Troast Construction Co., 657 Main Ave., Passaic, N. J. Estimated cost $120,000.

Oil Refinery—Searle Petroleum Co., 1024 North 17th St., Omaha, Neb., will construct a 1 story oil refinery on Locust St., East Omaha. Work will be done by day labor. H. C. Linnenkohl, Supt. for owner. Estimated cost $75,000.

Paper Mill—Marathon Paper Mills, Menasha, Wis., has awarded the contract for a 2 story, 110x220 ft. addition to Worden Allen Co., Port Washington Rd., Milwaukee.

Paper Mill—Union Bag & Paper Co., Hudson Falls, N. Y., will construct a part 2 story, 100x100 ft. addition to its plant by day labor. Estimated cost $40,000.

Paper Mill—Zellerbach Paper Co., N. W.; Fifth Ave., and Everett St., Portland, Ore., has awarded the contract for modernization of its 7 story mill and constructing modern warehouse to Reimers & Jollyette, Railway Exchange Bldg., Portland. Estimated cost $200,000.

Pharmaceutical Manufacturing Plant—Andrew Jergens Co., 2535 Spring Grove Ave., Cincinnati, O., has awarded the contract for a plant on Mill St., Belleville, N. J., James Stewart & Co., 230 Park Ave., New York, N. Y. Estimated cost $1,000,000.

Shoepolish Factory — Hecker Products Corp., West Morris St., Indianapolis, Ind., has awarded the contract for an addition to its factory to Carl M. Geupel Construction Co., 923 Hume Mansur Bldg., Indianapolis. Estimated cost $100,000.

Storage Facilities — Barnsdall Oil Refining Co., Corpus Christi, Tex., will purchase and construct steel storage tanks of 60,000 to 250,000 bbl. capacity on the lower ship channel. Work will be done with own forces. Estimated cost $500,000.

Fibreboard Products Warehouse—Fibreboard Products, Inc., Antioch, Calif., has awarded the contract for a 1 story, 80x370 ft. warehouse to K. E. Parker Co., 135 South Park St., San Francisco. Estimated cost $91,000.

Warehouse—Ducommun Metals & Supply Co., 219 South Central Ave., Los Angeles, Calif., has awarded the contract for a 290x600 ft. storage building and a 1 story, 20x400 ft. supplemental building at Vernon, Calif., to Pozzo Construction Co., 2403 Riverside Dr., Los Angeles. Estimated cost $300,000.

MARKET FOR CHEMICALS MORE ACTIVE WITH RISING PRICE TREND

THE usual influences which operate at the beginning of the fall months have been reinforced by the outbreak of hostilities abroad and there has been a noteworthy improvement in demand for commodities which has extended to chemicals and allied products. Some of the basic chemicals have not been affected but others, particularly those which depend on metal bases and those which figure prominently in foreign trade have shown signs of unusual conditions. The situation in general is one of adjustment to changes which the European crisis has brought about. Conjecture has been rife regarding the probable position of domestic markets and the possibilities which are held out for import and export trade. The experience gained from the world war is being applied and on this basis of comparison, it is held that domestic trading will gain in volume and foreign trade also will be enlarged so long as there is shipping space available.

The market for securities took an early lead in pointing out the direction in which prices are expected to go. Stocks of selected industries which respond more extensively to war-time demands naturally led in the rising movements. Higher prospective earnings in these industries must be predicated on a larger volume of business with possibly wider profit margins. Larger outputs of finished goods in almost any line means a larger consumption of chemicals since chemicals are used in such a wide variety of manufactures.

The development of a domestic chemical industry which is particularly self-sustaining is well illustrated by the present position of the market compared with the unsettlement which existed in the corresponding period of 1914. At that time, domestic production of dyes was more of a gesture than a reality. With the elimination of imports, the relatively small stocks of dyes held in this country were eagerly sought and prices soared to almost prohibitive heights. This brought about a revival of the use of vegetable dyes but textile and other users worked under handicaps which were the less severe because they were general. At present, the home dye industry not only is able to take care of consuming requirements but also has a surplus for export.

Potash was another material which soon became a rarity following the 1914 outbreak. Fertilizer manufacturers were forced to alter their formulas for mixed goods and cut down the potash content. Chemical manufacturers found difficulty in securing potash and expended considerable effort in an effort to provide a soda-base substitute which would answer the purpose of the potash salts. How well they succeeded is attested by the fact that some of the potash salts never have regained their former position of prominence in our markets and the soda products have held the advantage.

In surveying statistics for import trade in chemicals, there does not appear to be any thing of foreign origin which is basic enough to have any widespread effect if such imports are cut off. In the last war chrome ore was difficult to obtain or rather was difficult to transport owing to the lack of shipping facilities. However this condition was more acute after our entrance into the war when demands for moving men, war materials and supplies took up most of the tonnage.

Another phase of the chemical industry which is undergoing digestion is the future for export business. Here, considerable adjustment will be necessary. Naturally our trade with central Europe will amount to little if anything. Because of war-time needs, some other countries may materially alter their trading habits with a greater preference for materials which are regarded as essential and a reduction in demand for some of the chemicals which are now considered more or less established in that particular trade.

It is not the disturbance of old lines of trade, however, which is receiving most attention but the extension of markets in which our exports have played an unimportant part. This has particular reference to South America where some of the warring nations have maintained extensive negotiations over a long period. With this competition removed or greatly lessened, it is held that domestic products will have the call, and development along those lines may take on an air of permanence. It might be mentioned that during the late war years, individuals and companies shipped goods to South American ports where the quality of the goods, to put it mildly, were not up to specifications. That trading was done with irresponsible firms or individuals—the number was not large—does not destroy the fact that such business did much to destory good will.

From a market standpoint, the evidences of change in conditions is apparent most vividly in the movement of prices. A firmer tone rules in general but sharp advances have been posted in the case of metal salts, mercury, shellac, gums, and throughout the list of vegetable oils and fats. Imported materials may be expected to hold price-levels higher than normal. Ocean freights are bound to advance, insurance rates are higher, and the war risks involved in the movement of goods cannot be disregarded as price factors. Hence there are influences outside of the natural laws of supply and demand which are contributing to the price firmness and which will remain as factors as long as present conditions exist.

Exports of chemicals and related products continued at high levels in July, with every major item and classification on the list recording gains over shipments during the corresponding month of 1938, according to the Department of Commerce. The aggregate value of shipments during the month reached $13,459,000 which compared with $11,620,000 in July 1938. Outstanding gains were noted with exports of naval stores, medicinal preparations, chemical specialties, paint products, and fertilizers, according to the Chemical Division.

Imports of chemicals and related products were down sharply in July compared with levels attained during preceding months, but were well maintained in most instances compared with the corresponding month of last year. The aggregate value of chemical and related product imports, including drying oils and drying oil seeds, was recorded at $11,500,000 in July, compared with $13.066.000 during June and $9,865,000 in July, 1938.

Comparing July of the current year with the corresponding month of 1938, it is found that sharp gains were recorded in imports of gums, resins, balsams, crude drugs, fertilizer materials and oiticica oil, but that imports of tung oil, industrial chemicals, and coal-tar products were greatly reduced.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base = 100 for 1937

This month	**97.12**
Last month	96.96
September, 1938	99.55
September, 1937	100.51

Developments abroad have had a disturbing effect on prices. Imported chemicals are in a nominal price position with uncertainty regarding shipments. Many domestic chemicals have been revised upwards including most metal salts.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base = 100 for 1937

This month	**84.27**
Last month	66.80
September, 1938	73.54
September, 1937	89.42

Prices for many vegetable oils, particularly those of foreign origin are more or less nominal. Advances have been almost general throughout the list of oils and fats. Drying oils have been marked up but not as sharply as edible oils.

SEPTEMBER, 1939

CHEMICAL
& METALLURGICAL
# ENGINEERING

FACTS and FIGURES OF THE AMERICAN CHEMICAL INDUSTRY

1939 1940

cGRAW-HILL PUBLISHING COMPANY, INC.

FACTS AND FIGURES

OF AMERICAN CHEMICAL INDUSTRY

1939–1940 EDITION

AGAIN it is the privilege of the editors of *Chemical & Metallurgical Engineering* to present a factual picture of the present-day chemical industry of the United States. Its remarkable growth and development is of engaging interest not only to those of us who earn a living in its plants and laboratories but, as well, to people in all walks of life. It is of concern to the farmer, miner and forester who supply our raw materials and to the many industries who buy our products; to the railways, waterways and highways that transport our goods; to the bankers and investors who have supplied the funds; to the legislators and governmental agencies that constantly seek more adequate information about economic trends and their social implications.

To all of these, this issue should serve a useful purpose for we have tried hard to tell in an interesting, readable fashion the story behind the basic figures of chemical industry.

A second and equally important objective has been to give the industry itself a ready source of reference for data that bear on its daily work in production and distribution, research and development, management and administration. Special attention is called to the pages of current data that begin on page 572 and the verified list of those companies that produce chemical products on a large commercial scale.

To all who have collaborated in this comprehensive effort, we take this opportunity to express our gratitude and appreciation.

THE EDITORS

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Editor

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Associate Editor

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CHEMICAL & METALLURGICAL ENGINEERING

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WHAT IS CHEMICAL INDUSTRY?

Wherein we try to tell what we do and why we do it and thereby show where we fit into the scheme of things

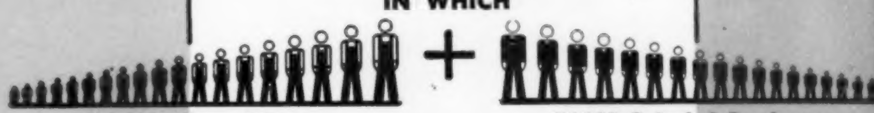
MOTHER NATURE provides us with all the raw materials necessary for human existence. Only rarely, however, can one take directly from farm or mine, from forest, air or sea, the commodities we want in that refined and dependable form which is most serviceable for our individual, home or industrial requirements. Hence one of the basic jobs of industry is to make over the crude products of Nature into more useful and therefore more valuable forms.

Seldom is this job merely one of purification. Far more often the task is one of manufacturing entirely new products of quite different chemical or physical character — materials which Nature herself has not given Man. Manufacturing involves changes not only in form, but in chemical composition and that, of course, is where chemical industry performs its major service. From Nature's five sources of raw material, the chemical manufacturer can produce almost every possible variety of product necessary to serve our fundamental human needs.

The layman comes into contact with but few of these chemical products, although they are extremely important just the same. Many of them are the so-called "heavy chemicals"—materials of large bulk at relatively low prices like sulphuric acid used in the automobile battery and a thousand places in industry; like soda ash, the washing soda of the housewife, but our single most important industrial alkali; or like ordinary salt, the most common of all heavy chemicals. Modern enterprise also requires the more costly and complicated products we know as "fine chemicals"—like the many kinds of dyes and pharmaceuticals, perfumes and flavors, and the widening field of synthetic organic chemicals. Then there are the important electrochemicals, like chlorine which is so vital in water purification or the carbide used in miners' lamps and as the chemical basis for synthetic rubber and other things. Compressed and liquefied gases, such as oxygen and acetylene are certainly chemicals. Finally, there are the wood chemicals (acetic acid and methanol) and naval stores (turpentine and rosin). All of these are but vaguely understood or little noticed by the layman, even those that concern him most in his everyday life.

When those who have reason to know most about chemical manufacture sometimes have difficulty in defining chemical industry, it is no wonder that the layman becomes confused. Chemicals, to him, are merely mysterious mixtures, solutions and salts. He is willing to call almost anything a "chemical industry" from the manufacture of hair tonic and cosmetics to soap and sugar. However, for the purposes of this issue of "Facts and Figures of American Chemical Industry" we are concerned

CHEMICAL INDUSTRY IS A GREAT FACTORY IN WHICH



120,000 Wage Earners + 24,000 Salaried Employees

PRODUCE FROM

$600,000,000 WORTH OF

RAW MATERIALS, FUEL and POWER OBTAINED FROM

MINE | FARM | FOREST | SEA | AIR

IN 2800 PLANTS

$1,185,000,000 WORTH OF THESE CHEMICALS:

Industrial Chemicals n.e.c.	$933,000,000	Salt	$33,000,000
Compressed Gases	$ 56,000,000	Tanning Materials	$36,000,000
Insecticides	$ 71,000,000	Naval Stores	$29,000,000
Wood Chemicals	$26,000,000		

U. S. Census 1937

WHICH ARE SOLD TO

THESE CHEMICAL CONSUMING INDUSTRIES

Chemical Mfg.	$275,000,000	Pulp & Paper	$35,000,000	Soap	$20,000,000
Textiles	85,000,000	Rayon	30,000,000	Rubber	15,000,000
Petroleum	90,000,000	Plastics	25,000,000	Coal Products	10,000,000
Fertilizers	57,000,000	Leather, etc.	25,000,000	Miscellaneous Industrial and Domestic Uses, including Exports	$400,000,000
Paint & Varnish	45,000,000	Glass & Ceramics	25,000,000		
Iron & Metals	40,000,000	Explosives	20,000,000		

CHEM. & MET. ESTIMATES

TO SERVE THESE FUNDAMENTAL HUMAN NEEDS

FOOD • CLOTHING • SHELTER • HEALTH • HAPPINESS • TRANSPORTATION • SECURITY

TABLE I—BASIC DATA FOR CHEMICAL MANUFACTURING INDUSTRIES *

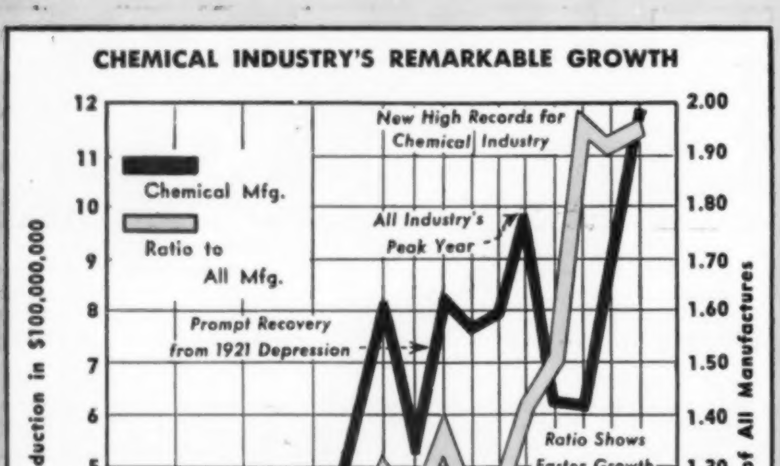
	1937	1935	1929
No. of Establishments	2,787	2,603	2,393
No. of Salaried Employees	24,035	21,516	29,212
Salaries Paid ($1,000)	58,031	51,351	75,279
No. of Wage Earners	119,779	86,017	81,634
Wages Paid ($1,000)	141,125	98,973	118,031
Cost of Materials, Containers, Fuel and Power ($1,000)	569,222	417,006	492,095
Value of Product ($1,000)	1,183,931	862,708	988,103

** Includes U. S. Census classifications for Chemicals, not elsewhere classified, (such as general inorganic compounds including acids alkalis and salts, general organic compounds including coal tar products, dyes, synthetic organic chemicals, and plastics); Compressed and Liquefied Gases; Insecticides and Fungicides; Salt; Tanning Materials; Natural Dyestuffs, Mordants, Assistants and Sizes; Turpentine and Rosin; Wood Distillation Products.*

TABLE II—BASIC DATA FOR CHEMICAL PROCESS INDUSTRIES *

	1937	1935	1929
No. of Establishments	14,133	13,795	15,846
No. of Salaried Employees	159,281	148,801	173,246
Salaries Paid ($1,000)	382,883	264,771	458,556
No. of Wage Earners	1,056,209	925,446	1,025,311
Wages Paid ($1,000)	1,329,724	984,205	1,363,669
Cost of Materials, Containers, Fuel and Power ($1,000)	6,930,593	5,134,434	7,156,447
Value of Product ($1,000)			
Chem. Process Industries	11,223,433	8,478,402	11,966,714
All Mfg. Industries	60,712,872	44,993,699	70,434,863
Per Cent of Total	18.5	18.8	17.4

** Includes U. S. Census Classifications for Chemicals (See Table I); Coke-oven Products; Drugs and Medicines; Perfumes, Cosmetics and Toilet Preparations; Distilled Liquors; Explosives and Fireworks; Fertilizers; Glass, Clay Pr:ducts and Refractories, Pottery Porcelain and Sand Lime Brick; Leather Tanning; Lime and Cement; Oils and Fats (Cottonseed, linseed and essential oils and greases); Paints, Pigments, Varnishes and Lacquers; Paper and Pulp; Petroleum Products; Rayon and Allied Products; Rubber Goods (tires, tubes, boots, shoes, etc.); Soap and Cleaning and Polishing Compounds; Beet and Cane Sugar Refinining; and Miscellaneous Products as follows: Coated Fabrics; Blacking, Stains and Dressings; Blueing; Bone Black, Carbon Black and Lamp Black; Candles; Manufactured Fuels; Glue and Gelatine; Graphite; Gypsum; Printing and Writing Inks; Linoleum and Asphalt-Felt Base Floor Coverings; Matches; Ground and Treated Minerals and Earths; Mucilage, Paste and other Adhesives; Photographic Materials; Paving Materials (other than brick and stone); Prepared Roofing; Wallboard and Building Insulation; and Wood Preserving.*



primarily with the Chemical Manufacturing Industries that are the producers of heavy and fine chemicals, and secondarily, with the Chemical Consuming Industries that are the chemical makers' best customers.

In this group of chemical-consuming industries we find the makers of fertilizers, pulp and paper, glass and ceramic products, manufactured gas and petroleum products, paint and varnish, oils and fats, iron, steel and other metals, rayon and synthetic fibers, textiles, coal products, leather, soap and sugar, explosives, rubber goods and plastics. These industries have come to be known as the "chemical engineering or chemical process industries."

The chemical engineer, more than any other factor, has welded these apparently diverse industries together with common bonds of technology—since all are dependent upon the same production methods and machinery, the same research and resources.

Basic statistics for the chemical manufacturing industries (See Editor's Note) as reported by the U. S. Census of Manufactures for the years 1929, 1935 and 1937 are given in Table I. Here it will be noted that the number of establishments and the value of production have gone far ahead of the former peak in 1929—a record that is shared with very few industries even among the chemical process group.

Growth and Expansion. The manufacture of chemicals as such represents only a small proportion of all manufacturing activity in the United States, if judged by the value of its production alone; even by such measure, however, it has become of increasing importance as is shown in Table III. It will be noted that 1914 marked the beginning of an era of expansion of chemical industry in the United States. Cut off from European im-

EDITOR'S NOTE: Careful distinction should be made in the use of statistical material from this issue in order to distinguish between those data which relate strictly to the chemical manufacturing industries and those which relate to the broader divisions of the chemical process industries. It is not proper, for example, to take data from two different chapters and undertake an inter-comparison without first making certain that at each point an identical basis of classification of manufacturing has been followed. An exactly uniform classification would have been highly desirable but it has not been possible because of the varied sources of information available for use. An effort has been made, however, clearly to define the scope of each presentation in this issue so that where such comparisons are proper, they can be made as accurately as the data permit. But casual comparison of dissimilar items may be misleading rather than helpful and should be avoided.

ports by the World War and stimulated to supply a large proportion of the military requirements of the Allies, the chemical industry of the United States had a tremendously rapid growth. Within five years the value of its production had trebled, reaching a total of $820,197,000, in 1919. After a slight setback by the depression of 1921, values quickly recovered and by 1923 the industry had begun a steady advance to reach a peak in 1929 of just a little less than a billion dollars. Then came the real depression and by 1933, chemical manufacturing had fallen to $614,-810,000. However, the recovery was both prompt and thorough; in two years the industry was almost back to 1929 levels and by 1937 had reached a new all-time high of $1,-184,000,000 as the value of its production.

Growth of the chemical process industries has been less spectacular. Representing approximately a fifth of the total of all manufacturing industries of the United States, that proportion has remained remarkably constant for the past 40 years. As is true of all industry, the group as a whole has not regained the peak values of 1929.

A Matter of M's

What are the characteristics of chemical industries that have made them so important in the national economy? The answer to that question is a matter of M's—of Men and Management, Money, Materials, Methods and Machinery, Merchandising and Markets.

Men—Reference has already been made to the role of the chemical engineer in welding together the divergent production interests of the chemical process industries. There has been an increasing penetration of technically trained men into the management of chemical enterprise. In 1918 the percentage of technical personnel in the dyestuff industry, for example, was 8.2; in 1930, it was 15.3. As research and technology have broken down the barriers between industries, there has been a greater interchange of personnel for the benefit of all concerned.

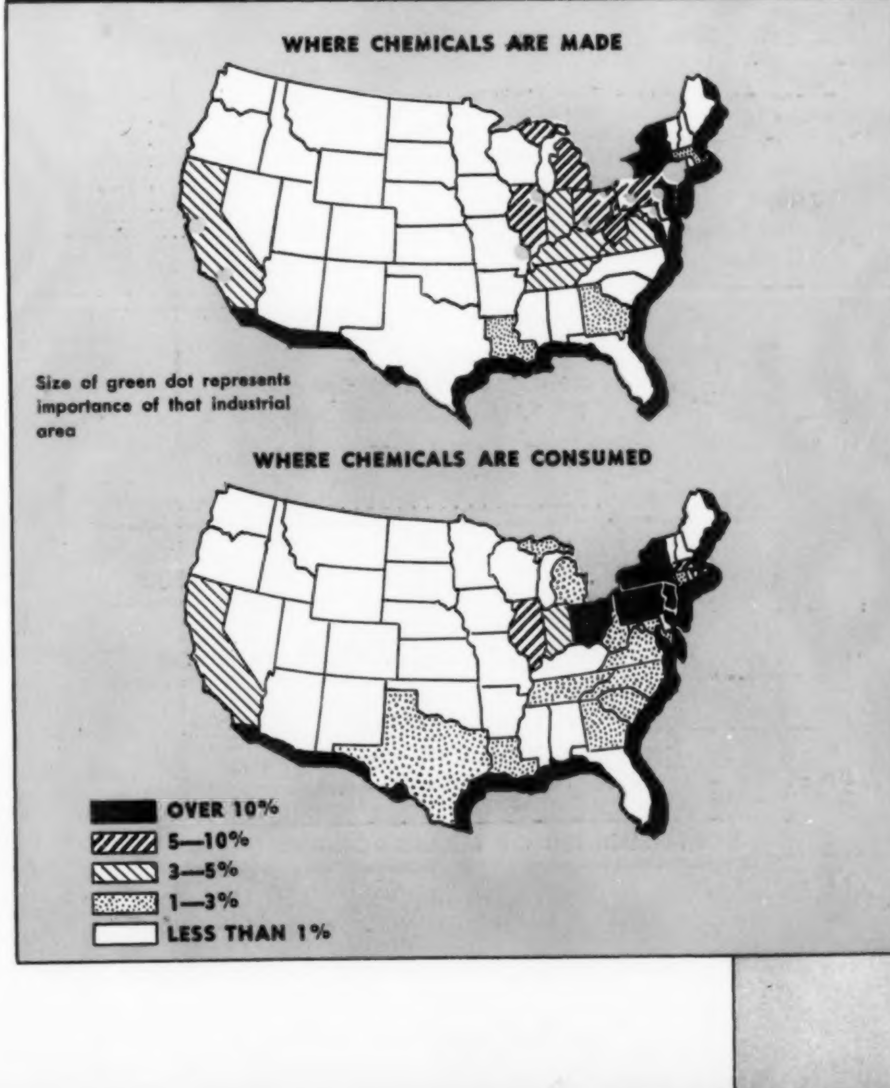
Money—That it takes money to make money is especially true in chemical industry. Capital investment per dollar of output is 50 per cent higher than for most manufacturing industries. Likewise the capital investment per employee is relatively higher. For an average chemical industry $11,250 must be invested in plants, equipment and working capital for each factory worker on the payroll. For most other industries it requires only about $7,000. Finally, because most

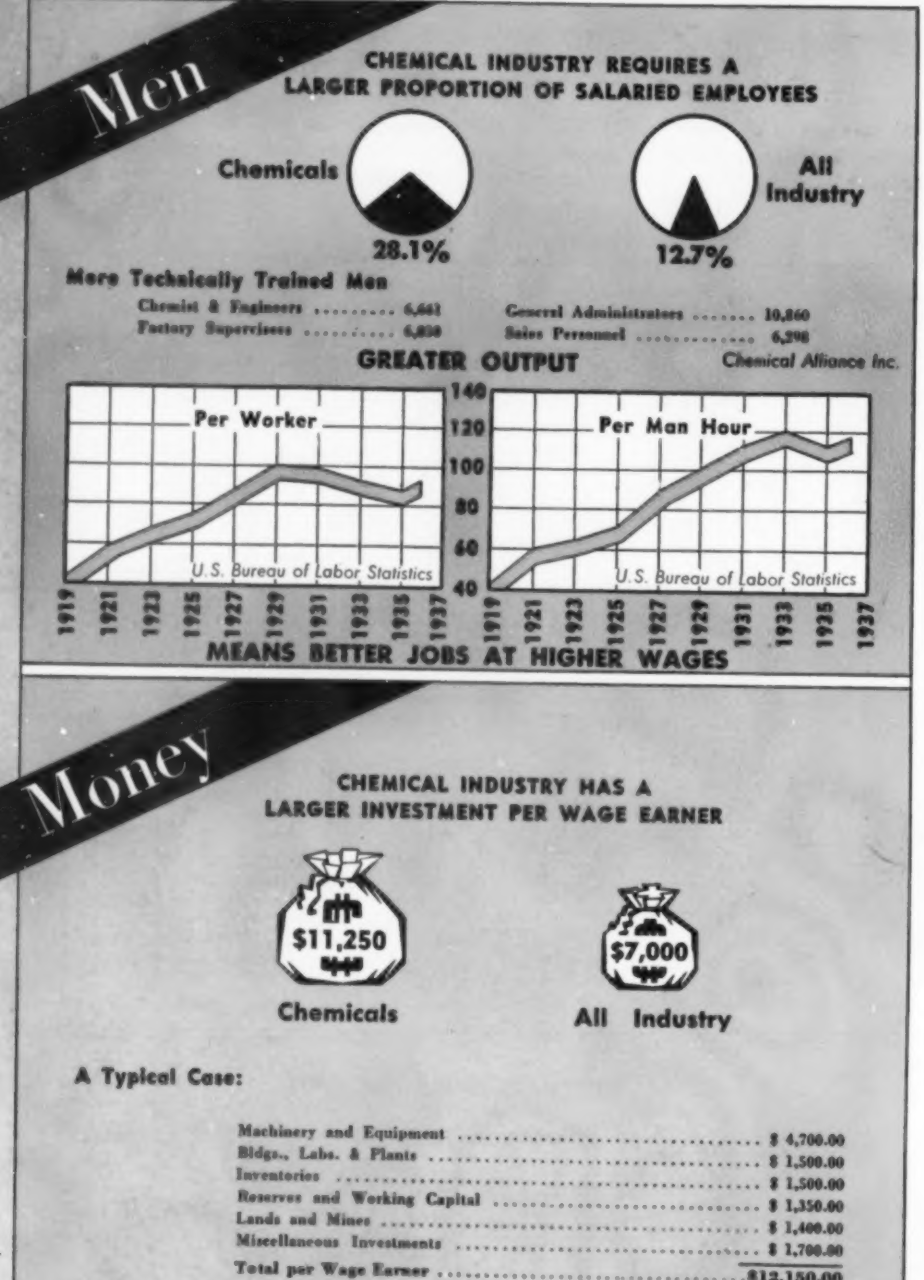
TABLE III—GROWTH OF THE CHEMICAL MANUFACTURING INDUSTRIES, 1899–1937

Census Year	Total Value of Chemical Production	Total Value of All Manufacturers	Per Cent of Total
1899	$ 93,418,000	$11,406,926,701	0.86
1904	137,715,000	14,793,902,563	0.93
1909	190,515,000	20,672,051,870	0.93
1914	239,235,000	24,216,515,000	0.97
1919	820,197,000	62,193,427,000	1.31
1921	535,468,000	43,653,283,000	1.22
1923	825,946,000	60,555,998,000	1.37
1925	764,700,000	62,668,260,000	1.22
1927	794,148,000	62,718,347,289	1.27
1929	988,103,000	70,434,863,443	1.39
1931	622,567,000	41,521,147,127	1.50
1933	614,810,000	31,400,000 000	1.96
1935	862,708,000	44,993,699,000	1.93
1937	1,183,931,000	60,710,073,000	1.96

TABLE IV—GROWTH OF CHEMICAL PROCESS INDUSTRIES, 1899–1937

1899	$ 2,105,278,610	$11,406,926,701	18.5
1904	2,853,889,346	14,793,902,563	19.2
1909	3,939,565,626	20,672,051,870	19.0
1914	4,803,776,616	24,216,515,000	19.8
1919	12,219,536,700	62,193,427,000	19.7
1921	8,533,839,320	43,653,283,000	19.6
1923	11,732,249,757	60,555,998,000	19.3
1925	11,511,277,000	62,668,260,000	18.4
1927	11,728,242,247	62,718,347,289	18.7
1929	11,966,714,000	70,434,863,443	17.0
1931	8,104,569,000	41,521,147,127	19.5
1933	6,594,876,481	31,400,000,000	21.0
1935	8,478,402,000	44,993,699,000	18.8
1937	11,228,433,000	60,710,073,000	18.5





chemicals must be produced continuously and on a large scale, in order to be profitable, larger plants are the rule rather than the exception. Thus 77.2 per cent of the total production is produced in plants having an annual output valued at $1,000,000 or over.

Materials—Most chemicals are industrial goods, i.e., they are sold to industries for further processing rather than direct to the individual consumer. Chemicals are the commodities that link together many dissimilar industries. The product of one enterprise is often the raw material of another.

Methods and Machinery—The unit operations and unit processes of chemical engineering and the equipment for carrying them into practice have probably done more than anything else to emphasize the mutuality of interest in the production problems of the chemical process industries. Continued progress is dependent upon research for new products and processes. Depreciation and obsolescene are higher than in most other industries, due as much to the rapidity of technical advance as to the severe conditions under which plants and equipment must operate.

Markets—Chemicals are sold to a wide variety of industries and for many different purposes. Yet the methods of marketing have much in common. Because of their chemical character, there must be closest cooperation between the producer and consumer, thus giving rise to the necessity for sales engineering and technical service—a distinctive feature of chemical industry. Because one chemical can often be replaced by another or be made by a different process, inter-commodity and inter-process competition are important factors in chemical marketing. By-products, joint products and waste products offer puzzling problems since it is usually necessary to find a balanced market in order to spread the cost on an equitable basis. Transportation and shipping sometimes cause large items of expense, and may become a considerable factor in delivered costs. So, too, is proper packaging to conform to strict requirements for safety and convenience and to avoid contamination.

Location and Localization—Chemical manufacturing is not a highly localized industry, despite the fact that fully half the production is concentrated in four states which, in order

of importance are New Jersey, New York, Pennsylvania and Illinois. Markets and transportation are generally more important than sources of raw material, labor and power—thus explaining the chemical concentrations in the metropolitan New York, Philadelphia, Pittsburgh and Chicago areas. On the other hand, cheap electric power was the attraction that made Niagara Falls, N. Y. the country's Chemical Capital earlier in this century. Coal, gas, oil and salt combine to give Charleston, W. Va. her present claim to chemical fame. The South and Southwest become of increasing importance because of growing markets and attractive sources of such raw materials as sulphur and salt, cotton and timber. California is a chemical empire in itself—approximately balancing its large production with its own requirements.

Fuel and Power—Chemical industry is peculiarly dependent upon coal, oil, gas and electricity—not alone for fuel and power as sources for heat and energy, but also as raw materials and actual reagents in its manufacturing processes. Great electrochemical plants often require more current than large cities. Hydrocarbons from petroleum and natural gas are the bases for the rapidly growing organic chemical industry that supplies us with solvents, plastics and new synthetic fibers. Coal is the underlying basis for a great many chemical operations.

Conclusion—So much for the identity, size and character of chemical industry. It exists primarily because of its contribution to the national economy, which, in turn, means its service in helping to fill fundamental human needs for food and shelter, clothing, transportation, health, happiness and security. Usually that contribution comes indirectly through a chemical process or chemical consuming industry.

But the chemical contribution is far more than that of a mere industrial necessity. Man could, if there were need, revert to cruder forms of textiles, to home tanning of skins and hides, and the direct use of other products of Nature. The result would be, however, a poorly fed, drab, uncomfortable and hazardous existence. What we have come to know as modern civilization would quickly disappear. Chemical industry's greatest service is to make the things that make the world a safer, healthier, happier place in which to live.

Methods

These Chemical Process Industries Use UNIT OPERATIONS AND PROCESSES

IN PLANTS THAT MAKE	Solids Handling	Liquid and Gas Handling	Disintegration	Mixing	Evaporating Distilling	Heating, Cooling, Freezing	Dry Separation	Wet Separation	Drying, Firing	Controlling	Chemical Reaction
Chemicals	X	X	X	X	X	X	X	X	X	X	X
Coke and Gas	X	X	X		X	X	X	X	X	X	X
Drugs, Medicines and Cosmetics	X	X	X	X	X	X	X	X	X	X	X
Explosives	X	X	X	X			X	X	X	X	X
Fertilizers	X	X	X	X	X	X	X	X	X	X	X
Glass and Ceramics	X	X	X	X			X	X	X	X	X
Leather	X	X	X	X		X			X	X	X
Lime and Cement	X	X	X	X		X	X	X	X	X	X
Oils and Fats	X	X	X	X	X	X	X	X		X	X
Paints, Pigments and Varnish	X	X	X	X			X	X	X	X	X
Paper and Pulp	X	X	X	X	X	X	X	X	X	X	X
Petroleum Products	X	X		X	X	X		X		X	X
Rayon	X	X	X	X	X	X		X	X	X	X
Rubber Goods	X	X	X	X			X		X	X	X
Soap	X	X	X	X	X	X	X		X	X	X

Machinery

THE CHEMICAL PROCESS INDUSTRIES USE THE SAME EQUIPMENT

EQUIPMENT FOR:

Solids Handling
Cranes, gantries, hoists, skips, drag lines; Conveyors — belt, screw, elevator, buckets, flight, vibrating, pneumatic, chutes; Trucks — industrial (power and hand), automotive; Stackers, skids, bins, hoppers.

Liquid & Gas Handling
Pumps—plunger, piston, rotary, centrifugal, turbine, vacuum; Compressors, fans, blowers, ejectors, boosters; Piping, valves, fittings; Tanks, gas holders.

Packages and Containers

Disintegration
Crushers—jaw, gyratory, disk, rolls and other mills; Grinders—ball, hammer, ring-roll and cage mills, rolls; Pulverizers—hammer, ball, tube, rod, stamp, ring-roll, ball-and-race, rollers, attrition and buhrstone mills; Shredders, chippers, slicers, masticators, pulp grinders; Colloid mills.

Chemical Reaction
including Fabrication to specification: Spray nozzles; Autoclaves; Kettles; Retorts; Nitrators; Digesters; Vulcanizers; Electrolytic cells; Special castings, welded and forged equipment.

Mixing
Mixers—flight and screw, chasers, tumbling barrels, barrattes, rolls; Agitators—turbine, propeller, paddle, air; Kneaders — double arm, rolls, chasers; Emulsifiers—turbine, paddle, propeller, homogenizers.

Stills, Evaporators, Heat Exchangers
Stills—pot and pipe, bubble and plate columns, tower packing; Evaporators — atmospheric, vacuum, film, forced-circulation, single- and multiple-effect; Heat Exchangers, condensers, coolers, preheaters.

Dry Separation
Screens, sieves, bolters; Dust collectors, air filters, electrostatic separators; Magnetic separators; Air separators, cyclones, settling chambers, scrubbers.

Wet Separation
Filters, thickeners, clarifiers, dewaterers, classifiers; Hydraulic presses, expellers; Flotation cells, dialyzers; Centrifugals; Crystallizers.

Dryers
Dryers—atmospheric and vacuum, tunnel, truck, pan and tray, conveyor, rotary, drum, festoon, spray.

Air Conditioning and Refrigerating
Air conditioners, unit heaters, unit coolers; Ammonia and other compressors, ejectors.

Power Transmission
Belting, chain drive, speed reducers, gears, speed changers; Pulleys, shafting, couplings, bearings.

Lubrication
Oils and greases; Lubrication systems, grease cups, alemite and other fittings.

Steam and Power
Boilers, stokers, economizers, feed water heaters; Turbines, steam engines.

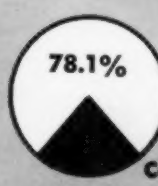
Electrical Uses
Motors, Generators, Transformers; Starters, Switches.

Control Instruments
Flowmeters, gages, thermometers, pyrometers, tachometers, psychrometers, gas analyzers, gravity meters, wattmeters, voltmeters, ammeters, frequency meters; Samplers, proportioning pumps, feeders, scales.

Construction Materials
Metals and alloys; Refractories and cements; Plastics; Rubber and rubber linings; Paint and other protective coatings; Roofing, flooring, grating, fencing.

Markets

CHEMICAL INDUSTRY IS ITS OWN BEST CUSTOMER



Fifteen Chemical Markets in Order of Their Importance

1. Chemical Mfg.
2. Textile Finishing
3. Petroleum Refining
4. Fertilizers
5. Paint & Varnish
6. Iron & Metals
7. Pulp & Paper
8. Rayon
9. Plastics
10. Leather
11. Glass & Ceramics
12. Explosives
13. Soap
14. Rubber Goods
15. Coal Products

CHEMICAL PROGRESS AND ACHIEVEMENTS

Research is the catalyst that helps chemical industry create new products, new services and new jobs—all of which contribute to the national welfare

TRULY great achievements and the less spectacular but important progress of the chemical industry come largely from research. No other division of American industry is so aggressive in its scientific investigations or so generous in its support of new developments. It is not surprising, therefore, that the chemical industry is constantly undergoing change or that improvements and progress are of every-day occurrence.

There may be many measures of this progress or achievement. Some conceive of it in terms of mere growth, enlargement of business, new plants, greater payroll, greater value of the products sold. Even judged by that limited measure, the chemical industry has had great success in recent years. Others use the measure of profit as a gage of progress. In that regard the chemical industry has not been laggard for even during the depression years it earned a fair return on its relatively large capital investment. But the real measure of progress and achievement should be the greater service of the industry to the national welfare. That measure will be the basis of the following discussion.

A substantial part of American chemical industry is comparatively new. Many of the products of the major chemical companies did not exist as articles of commerce ten or twenty years ago. In a recent announcement, one of the largest manufacturers of chemicals in the United States stated, "Twelve new lines of products developed since 1928 account for about 40 per cent of our total sales." Analysis of another of the larger chemical companies indicates that for three of the four major divisions of its activity almost every product marketed is the result of research and a large majority have been developed and commercialized since the World War.

Chemical industry is far from static. New products and new services are constantly being provided by its researchers. The everyday use of many of these items obscures their importance. Take, for example, three aspects of the family automobile. It now comes from the factory with practically a life-time finish. Were it not for the scratches and bumps of traffic, refinishing of a car would never be necessary, from assembly line to scrap pile. This advantage is the direct result of chemical research on nitrocellulose, synthetic resins and other plastic materials which have replaced the old-fashioned, slow-drying paints and varnishes.

In the cooling system of the modern car is an anti-freeze compound that protects the motor and radiator both from freezing in winter and corrosion and tendency to stoppage in the summer season. This is possible because of the synthetic chemical developments that give us generous

RESEARCH HAS CONTRIBUTED TO
SECURITY and HEALTH

A By Successfully Producing

NITRATES From AIR for Fertilizers, Explosives

IODINE From OILWELL BRINES for Medicines, Food Deficiencies

POTASH From MINES & BRINES for Chemicals & Drugs, Fertilizers

SYNTHETIC CHEMICALS From COAL-SALT-LIMESTONE for Dyes & Pharmaceuticals, Plastics & Resins, Film & Fibers

B By Conquering Water-Borne Diseases with Chlorine, Hypochlorite, Ammonia, Alum.

C By Developing Such Specific and Effective Remedies as Salvarsan, Insulin, Sulphanilamide and Sulph-pyridine.

D By Identification and Synthetic Production of Vitamins for Proper Diets Regardless of Food Supply.

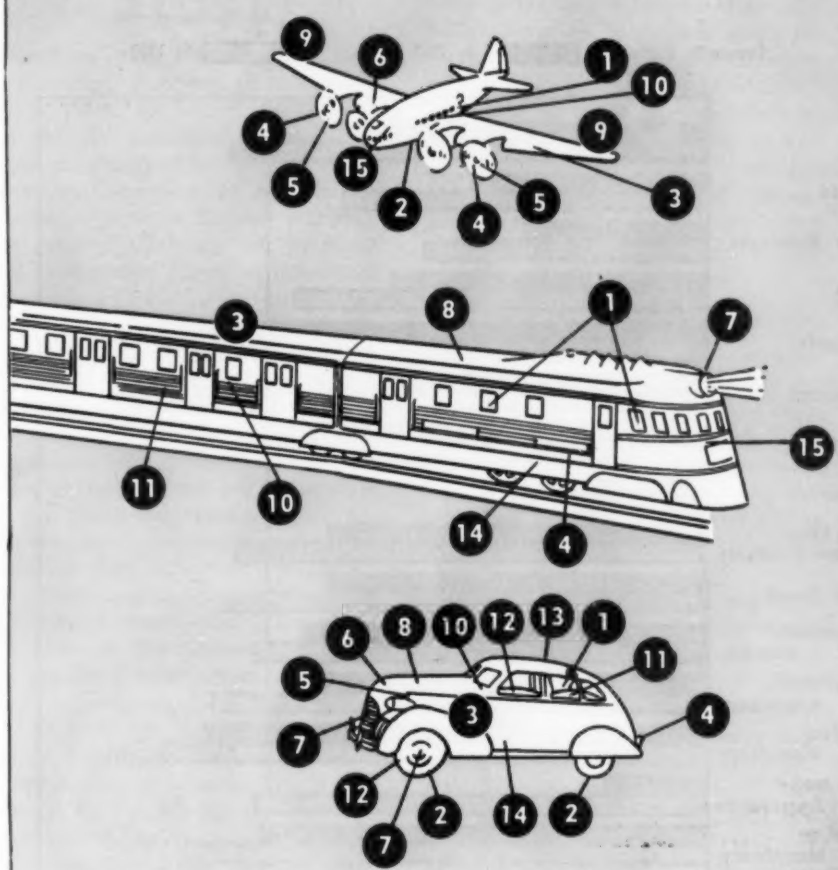
E By Providing Refrigerants that have made possible the Universal Availability of Refrigeration for Food Preservation.

F By Making Available a Wide Variety of Insecticides, Fungicides and Disinfectants.

THOUSANDS AND THOUSANDS OWE THEIR LIVES
TO CHEMICAL RESEARCH.

RESEARCH HAS CONTRIBUTED TO THE COMFORTS AND CONVENIENCE OF

MODERN TRANSPORTATION



1.) Safety Glass
2.) Long Life Rubber
3.) Synthetic Resin and Lacquer Finishes
4.) Anti-Knock Motor Fuels
5.) High Temperature Lubricants
6.) Anti-freeze Solutions
7.) Chromium Plating
8.) Stainless Steels and Alloys
9.) Aluminum — Magnesium — Alloys
10.) Molded Plastics
11.) Artificial Leather
12.) Rayon and Synthetic Fibers
13.) Sunfast Dyes
14.) Better Batteries and Electrical Accessories
15.) Instruments and Controls.

supplies of methanol and glycol, along with either synthetic or fermentation alcohol, and all accompanied by anti-evaporant, anti-corrosion components that have resulted from careful and elaborate research by chemical industry.

In the gasoline tank, at the rear of the same car, practically unnoticed by the average motorist, is an anti-knock compound constituting but a fraction of one per cent of the motor fuel. Without this product of one of the most elaborate researches America has ever known, it would not be practical to operate the modern high compression engine. In fact, motors with high compression ratios which make for both efficiency and fleetness in modern traffic would never have been built had the chemical industry not made combustion control by chemical means a practical possibility.

The bromine that goes into that anti-knock compound is extracted from sea water, which contains only 67 parts per million. The chemical company that developed the unique extraction process handles approximately 4,000,000 gal. of sea water to produce a single ton of bromine. This plant is treating approximately 200,000,000 gal. of water per day, which is more than three times the total amount of water consumed by cities the size of San Francisco.

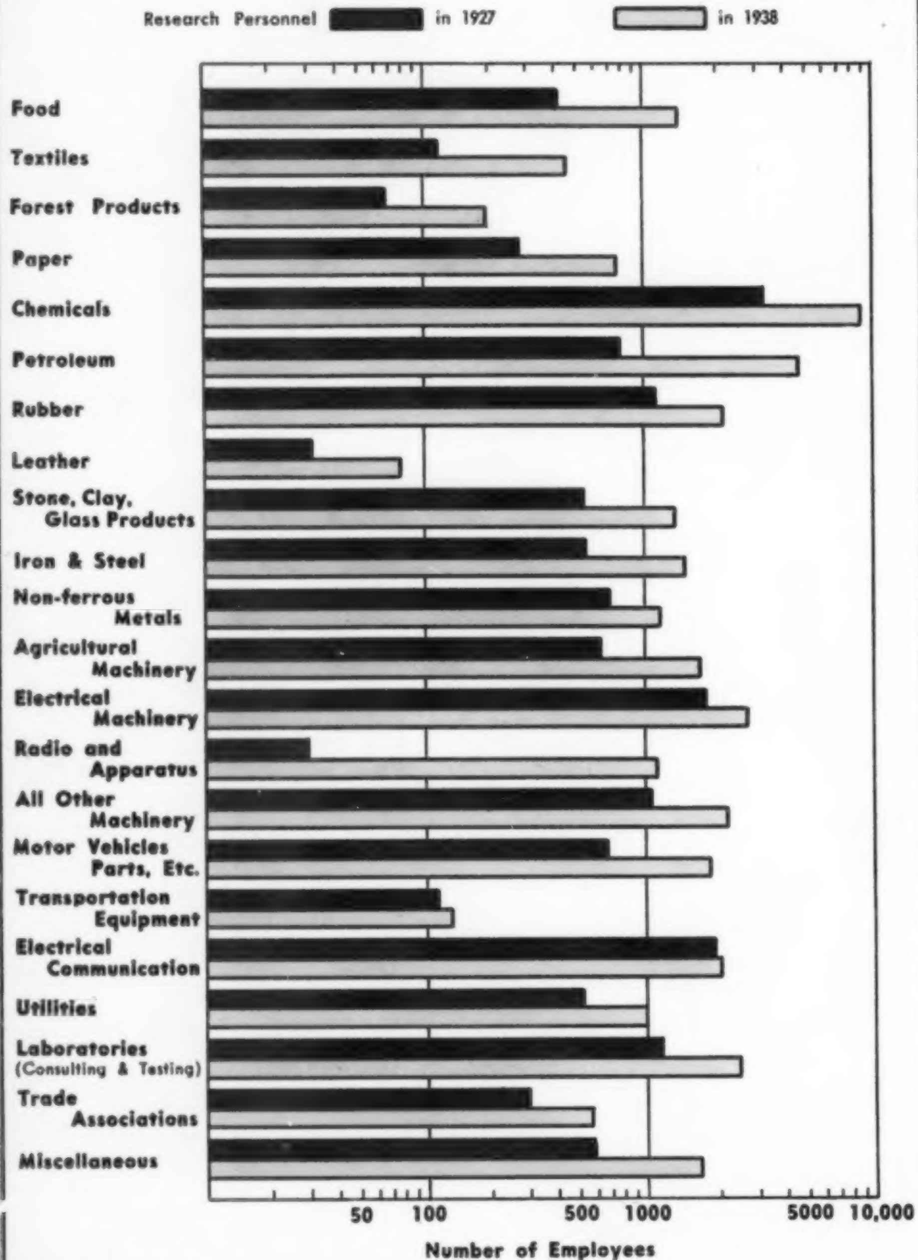
Thousands of other examples could be given of new chemical products and processes that supply us with the necessities of every-day life. They constitute a real measure of public service, a valid basis for the claim of progress and achievement by chemical enterprise.

National Self-sufficiency

America is more nearly self-sufficient as to raw materials for industrial activity than any other nation of the world. Therein lies one of its greatest elements of strength and one important factor in its world influence both for industry and for peace. But even America has need for many goods from abroad, some of which are irreplaceable in our modern economy. To supply these from sources within the United States, generally by synthesis from simpler available materials, has long been one of the important tasks of the American chemical industry.

At the end of the World War the United States government identified as of strategic importance nearly 50 commodities for which this country was dependent on imports. That list has gradually shrunk as chemical research has made available from domestic materials the same or equivalent supplies for industry and the general public. Most spectacular of the strategics removed from the old list is perhaps Chilean nitrate, replaced by atmospheric nitrogen products made better and cheaper in the United States. Scientific methods have made possible the development and use of other mineral raw materials not heretofore available. The potash brines of California and the remarkable salt deposits of New Mexico have thus been processed economically by chemical methods so that more than half of the domestic supply of this essential chemical is already being obtained from these sources. All the

CHEMICAL INDUSTRY IS THE LARGEST USER OF RESEARCH



Source: W. P. A. Nat. Research Project

BEHIND EVERY 10,000 CHEMICAL WAGE-EARNERS ARE 300 RESEARCH WORKERS

Compared with

2 for Textiles	**41 for Automobiles**
15 for Iron & Steel	**116 for Electrical Mfg.**
16 for Food Products	**173 for Rubber Goods**
28 for Pulp & Paper	**563 for Petroleum Prod.**

potash needs of the country could be supplied on short notice should imports be cut off.

During the World War one of the greatest chemical needs was for glycerine. The glycerine type of soaps disappeared from the drug store and the grocery. This component of soaps, medicines and cosmetics was so much more valuable for the making of nitroglycerine that Uncle Sam demanded every pound for that use. The real problem, however, was that the quantity of glycerine available depended altogether on the crude material obtainable only as a byproduct in soap manufacture. At present that is not the sole source of American glycerine supply. At least three other methods are available for synthesis of this chemical, quite independent of soap making. Thus, should there be need of more glycerine, we would not have to make more soap in order to get it. Synthetic processes using petroleum gases or starch as raw materials, could readily be expanded to yield abundant supplies of glycerine.

A similar instance of byproduct development is found in the case of toluol. This commodity is essential for the manufacture of military explosives, particularly the familiar trinitrotoluol that even the layman came to know as TNT during World War days. Toluol is one of many byproducts of coal carbonization. In other words the quantity available depends upon the amount of coke produced. Now, however, chemical industry has largely removed this limitation. By new chemical technology, the quantity of toluol produced from a ton of coal may be tremendously increased or its equivalent can be made from petroleum hydrocarbons by new chemical processes. Thanks to research, there appears to be little, if any, danger that even an extreme military emergency would again find serious shortages of toluol in the United States.

Better to Serve the Farmer

The fertilizer industry is perhaps the largest single customer of the heavy chemical manufacturer. This industry is vital to the well being of American agriculture. It has made possible increased yields on the American farm with lower costs than those of even 20 years ago. This important social service has come largely from chemical research.

In the period just before the World War, American fertilizer manufacturers depended largely on the im-

ported nitrate, imported potash, and on superphosphate made with relatively expensive sulphuric acid. The mixture of these chemical commodities with many trade wastes was sold for fertilizer purposes and the raw material cost was typically about $12 per ton of fertilizer which contained only about 15 per cent by weight of plant food.

Today the fertilizer industry operates on a different basis. It gets cheap sulphuric acid from its own or other chemical plants and uses phosphate rock of greatly improved quality, prepared at much lower cost than heretofore. It has unlimited domestic supplies of nitrogen compounds of higher purity and at a much lower price than before. Chilean nitrate and ammonium sulphate which cost the fertilizer manufacturer about $50 to $60 a ton before the war are now abundantly available (from synthetic as well as natural sources) at about $25 to $30 per ton, and of equal or higher purity.

Much more of these basic chemicals is now put into each ton of mixed fertilizer. As a consequence the American farmer today gets over 25 per cent more plant food per ton of fertilizer at a price about 10 per cent less than he paid before the war. And all this has been achieved by improved chemical manufacture despite greatly increased cost for transportation, tremendous increases in wage rates at the fertilizer factory and a continuation of very bad buying and marketing practice caused by the farmer himself.

High Productivity

The output of chemicals per wage earner has advanced steadily for many years. Today nearly three times the quantity of goods is made per man-hour as was produced in 1919. Some labor leaders have worried about this development, thinking that tripling the productivity means that only one-third as many men can find work in chemical industry. That has not been the case. On the contrary, quite a different benefit has developed both for the public and for labor.

A natural result of high productivity has been lower cost per unit of goods made. It has been a consistent policy of the chemical industry to pass on to the customer and to the wage earner as much as possible of this benefit. The rate paid per hour to highly productive employees has been constantly raised, as will be shown in the next chapter of this issue. And the prices of goods have been lowered as will be noted in still another chapter.

Values from Wastes

Much of chemical industry is a multi-product business. A raw material is taken as Nature provides it and this is processed primarily to make one commodity. But there are many other components and derivatives obtained from the raw material. For greatest efficiency, all must be used. Otherwise there is economic waste.

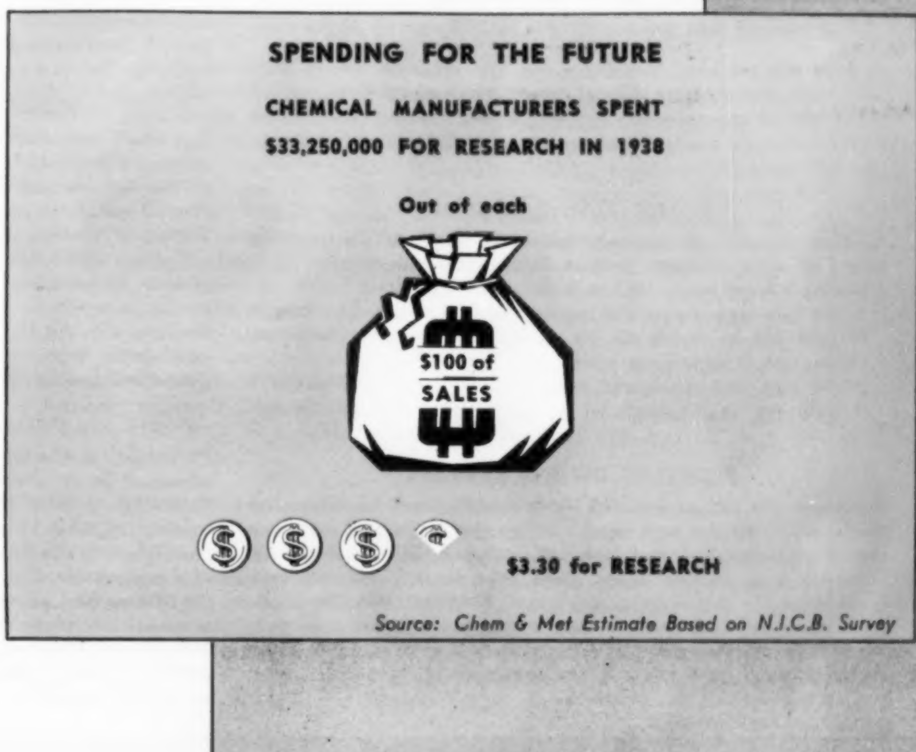
A great deal of chemical research of recent years has been undertaken to offset the problems of byproducts and wastes. Not infrequently, new products and new services of greater importance have developed. In a few cases processing the old byproduct has become as important as, and occasionally more important and more profitable than, what was originally the primary activity.

An important secondary benefit of this type of development has been the practical elimination of waste-disposal problems. It is not uncommon to hear the statement that the process industries cause most of the contamination of streams, rivers and harbors. That is not the fact. Careful governmental surveys show that municipalities themselves through ineffective sewage disposal methods are responsible for the vast majority of water pollution troubles. Chemical enterprise, along with other manufacturers, has not been altogether blameless in the past, but today there is little or no such problem. Many millions of dollars have been spent for corrective measures; but, fortunately, research has made for more complete utilization of many raw materials so that today it is often profitable as well as practicable to protect American waterways against industrial contamination, merely by the effective recovery of what was previously regarded as waste.

Short Shrift for Monopolies

In the chemical industry there remains little or no opportunity for monopoly. To be sure, there are cases in which there is only a single company or a very few companies making certain chemical compounds. But this does not constitute monopoly in the usual meaning of that politically explosive word.

Chemical compounds are rarely, if ever, irreplaceable. The research laboratory can supply a variety of commodities for practically every sort of industrial and public service. The intercommodity competition which results is peculiarly a characteristic of chemical enterprise. If one firm sets too high a price, or otherwise restricts the sales of its commodities, another firm will come along and make them or, more likely, some-



thing else that is just as good, possibly even better. Then away goes the business of the first enterprise. History proves that monopolistic practices are short-lived and unprofitable in chemical industry.

No other division of American enterprise uses so large a percentage of its employees on research and development work as does the chemical industry. A recent national research project sponsored by the WPA shows that about 300 research workers are so engaged for each 10,000 persons on the industry's payroll. This is only exceeded by the petroleum industry which has come up so rapidly in recent years as to be the largest employer of chemical and chemical engineering graduates. Of 25,000 technically trained men and women who have gone into research work since 1927, more than 40 per cent have found employment in the chemical and petroleum industries.

Much of the chemical sales dollar is used for this type of research and the development work. A survey made this year by the National Industrial Conference Board shows that 3.3 per cent of the gross income of chemical companies was paid out last year for research alone. In the organic chemical division of the industry the ratio has been somewhat higher, averaging between 4 and 5 per cent in recent typical years for those synthetic organic chemical manufacturers who report annually to the United States Tariff Commission. But even the older, seemingly unchanging, heavy chemical enterprises spend substantial parts of their income for research. If they do not do so, they are likely to pass out of the picture under the mounting pressure of competitive effort for reduction in cost or improvement in quality of products.

Tabulated below are the results of typical research projects recently completed in chemical industries.

SOME TYPICAL RESULTS OF RECENT RESEARCH

BETTER THINGS FOR BETTER LIVING

A company that invests about $7,000,000 a year in research and development work reports as follows on some of the results of this investment:

Year	Product or Process
1923	Nitrocellulose lacquers
1927	Cellulose film
1928	Synthetic resin enamels
1929	Acetate rayon
1931	Titanium pigments
1932	Synthetic rubber
1933	Synthetic camphor
1934	Rayon tire cords
1935	Urea-ammonia fertilizers
1936	Acrylic acid plastics and resins
1937	Textile fire retardents
1938	Sink and float process

Results Achieved

Employment increased from 10,700 in 1928 to 18,000 in 1938—in other words, 7,300 new jobs directly traceable to these 12 lines of research and development.

Plant Investment increased from $65,000,000 in 1928 to $174,000,000 in 1938—indirectly creating several thousand additional jobs.

Prices reduced from an index number of 100 in 1928 to 60 in 1938.

Wages increased from an average of $24 per week in 1929 to $31 in 1938—nearly 30 per cent.

In 1939 this company introduced the first synthetic textile fiber to be made entirely from mineral raw materials and then proceeded to appropriate approximately $10,000,000 for its manufacture. Many regard this as the outstanding research achievement of recent years.

STABILIZING EARNINGS

Another measure of research values is found in the ten-year record of a second large investor in chemical research:

During 5 boom years, 1925 to 1929:	
It put into new plants and equipment	$80,000,000
It paid out in dividends	80,000,000
During the 5 depression years, 1930-1934:	
It put into new plants and equipment	70,000,000
It paid out in dividends	80,000,000

FIGHTING BUGS AND PESTS

An insecticide and agricultural spray manufacturer has increased employment 400 per cent since 1929 as the result of developing highly concentrated liquid insecticides that could be applied by atomizing into fog-like mists. Each year insects, bacteria and fungi cause the nation an annual loss of $3,000,000,000. The U. S. Department of Agriculture estimates that $100,000,000 are spent yearly by various agricultural enterprises for pest and disease eradication and for developing new and more effective insecticides to improve agricultural production.

TO ALLEVIATE HUMAN SUFFERING

A company that has served as manufacturing chemists to the medical profession since 1858 reports that new products developed through research since 1929 now account for 40 per cent of its current sales. The parent company has increased employment since 1930 by approximately 450 employees—an increase of 25 per cent. One subsidiary company has added 203 employees, representing a percentage increase of 32 per cent. Last year this company spent approximately $1,000,000 for building and equipping its new research laboratory.

DIVIDENDS ON $1,000,000

A diversified chemical industry that has contributed to the development of improved safety glass, new phosphorus derivatives, medicinals, synthetic phenol and other organic chemicals reports that the number of employees in those plants which it has operated continuously since 1931 had just doubled in 1938. In other words, 1,772 new jobs are directly traceable to new developments growing out of its research program which costs about $1,000,000 a year.

MAKING BETTER PRODUCTS CHEAPER

A small middlewestern chemical manufacturer serving principally the ceramic, electroplating and paint industries, traces an increased employment of 100 men since 1929 to research directed toward improvement of products and cheaper manufacturing methods. This is a payroll increase of about 20 per cent.

MORE JOBS IN ALKALI PLANTS

One alkali manufacturer's research has led to the development of successful methods for the transportation of rayon-grade high-test caustic soda in tank-cars without contamination. More than $7,000,000 has been spent in plant additions and improvements since 1929, thus resulting in substantial increase in employment.

Another alkali manufacturer has developed a unique process for making chlorine without caustic soda and has doubled the output of its synthetic ammonia plant which is now believed to be the largest in the United States. To meet specific requirements of agriculture, improved solutions of nitrate salts in ammonia have been developed for fertilizer use. Employment is far ahead of 1929.

PHOSPHATES FOR PROGRESS

Production of elemental phosphorus and its derivatives has been advanced by a chemical manufacturer who has invested over $2,250,000 in new electric furnaces since 1938. The company constructed what is probably the largest tetra sodium pyrophosphate plant in the country. Its research has led to the development of a process for eliminating fluorine from drinking water by the use of lime and phosphoric acid. It has developed a new type of mono-calcium phosphate for baking purposes, which it is believed will stimulate the per capita consumption of wheat flour. Since 1929 this company has given employment to between 400 and 500 additional men.

A Synthetic Chemical Era Ahead?

It is always fashionable to forecast new eras. Every modern faddist envisions a new type of living or new prevailing habits that center largely around his own self interest or fields of activity. Today, however, it is not the chemical manufacturer nor his research man who talks most about our chemical future. Popular fancy has been so taken by many recent chemical developments that it is the man in the street who tells you that America is entering a new synthetic chemical era. Or he speaks knowingly of a new "plastic age."

After all, such terms may be more or less justified. As the result of research there are available in this country and abroad today hundreds of new chemical compounds that were entirely unknown ten or twenty years ago. Organic chemical research is such that these materials can now be "tailor-made" to fit almost any conceivable requirement for new industrial and household applications. Our great and growing family of industrial plastics does promise interesting and exciting competition with many of the standard materials of today.

It is, of course, absurd to assume that the new synthetic plastics are going to supplant all natural materials and completely recast the habits and living conditions of this country. But it is not a mistake to assume that progress in research will continue at an accelerated pace. In fact each new invention seems to inspire more new developments. Progress is self-catalyzing. One may reasonably forecast, therefore, more and more spending for research, more and more new opportunities for improvement, more and more new services and many new advantages to the industry itself, to its customers and to the general public.

PROGRAMS OF CHEMICAL MANUFACTURERS

FROM SMALL BEGINNINGS

A rayon and cellulose film manufacturer began production in 1929 and at the end of that year had 200 employees. In ten years the business has grown until it gives direct employment to over 1,600 people and indirectly provides a livelihood for perhaps 2,000 more workers in plants that use its products.

IN THE PUBLIC INTEREST

Purification of liquid chlorine to eliminate organic impurities, which are particularly objectionable in equipment used for the accurate control of water purification as in municipal water plants, is a research achievement in the public interest. The same company developed a fluorine insecticide particularly efficient in controlling chewing-types of insects. It contributed an advance to its customers and to the industry as a whole by developing a new and superior type of metal alloy for the protective fusible plugs used for liquid chlorine cylinders and other containers.

CUSTOMER SERVICE

An example of a service to a consuming industry is the development of a direct one-bath process for the chrome tanning of white leather. Thus the tanning industry is now able to produce a white leather without bleaching and other batch operations that formerly added to costs and delayed production.

CHEMICAL CASINGS FOR SAUSAGES

An enterprising company based on chemical research has developed a new moisture-resistant artificial sausage casing which is suitable for the packaging of liver sausage—something that has heretofore been thought impossible. It was achieved only after 2½ years of steady research. A significant commentary on this comparatively new industry is that the prices for its product have been steadily reduced as a result of improvements in the manufacturing process. Today's prices are only one-sixth of what they were in 1927. This company has increased employment by approximately 600 new jobs since 1929.

INCREASING SULPHUR'S SERVICES

Not all research, by any means, is conducted in industrial laboratories. One of the sulphur companies, for example, has sponsored a broad research program in cooperation with state and other agricultural experimental stations through research fellowships at several universities and by grants of funds and contributions of materials. Some of this work in Texas and Louisiana has led to sulphur-dusting methods that have considerably reduced the damage caused by the cotton flea hopper. Work in Virginia, North Carolina, Georgia, Florida, Alabama and Texas on dusting peanuts with sulphur to control leaf damage has increased yields of field-cured nuts from 20 to 80 per cent. Research sponsored in Delaware, Maryland, Louisiana and Texas indicates a satisfactory method of controlling coccidiosis—one of the most serious and universal poultry problems. Work at Cornell has been directed toward the effect of sulphur fumigation on forage crops and the effect of sulphur sprays on photosynthesis in many plants. These investigations of the uses of sulphur in agriculture have been of aid not only to farmers, but to the sulphur industry itself and to those customers who process and sell sulphur for such purposes.

RESEARCH FOR DIVERSIFICATION

Research offers a means of diversification through the opening of new lines of development. Thus an important manufacturer of explosives entered the naval stores industry some years ago to develop a novel process. A broad program of research was initiated which led to the commercial production of improved grades of turpentine and rosin. Then followed the development of a series of entirely new chemical derivatives, including most recently a hydrogenated rosin which because it does not oxidize or discolor, is a valuable substitute for expensive natural gums. The naval stores research carried the company further into the lacquer and resin industries and led to the large scale production of cellulose acetate, ethyl cellulose and chlorinated rubber. Another logical expansion was in the direction of developing and supplying new materials for the paper-making industry. Measured in terms of employment, this chemical diversification has meant an increase in this company's payroll from 4,077 employees at the end of 1929 to 5,620 as of June 30, 1939—a gain of 38 per cent.

BASIS FOR NEW INDUSTRY

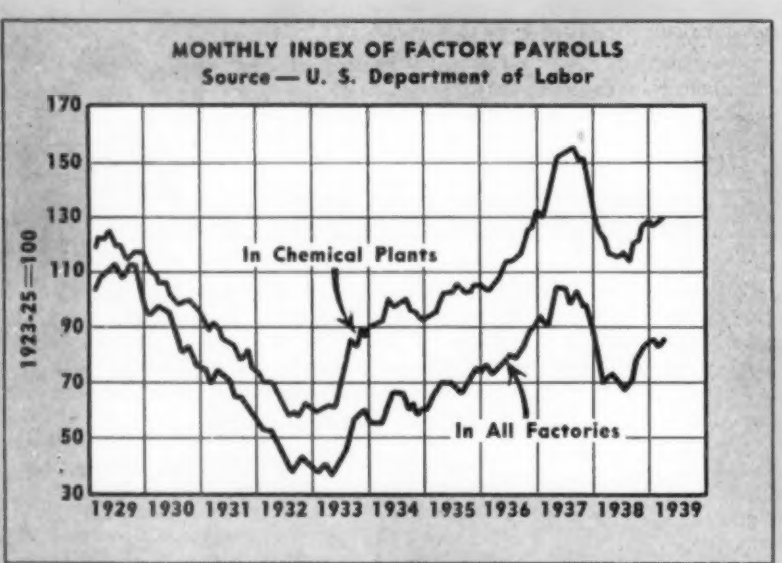
In 10 years one of the solvents manufacturers has increased employment by 49 per cent—from 817 in 1929 to 1,218 in 1939. This handsome increase has resulted largely from the development of new chemical derivatives and new lines of manufacture based on the company's original products—butanol, ethyl alcohol and acetone. Several years ago a unique research program was organized with the advice of a committee of distinguished scientists representing several of the larger educational institutions. Under the guidance of these qualified research consultants the company has now embarked on a still further development that will shortly make available on a commercial scale an entirely new series of chemical compounds. These nitro-paraffines are not only expected to find considerable use as solvents, but will also serve as raw materials for a wide variety of organic chemical syntheses. Thus university research, backed by sound industrial support, has laid the basis for a still greater organic chemical industry.

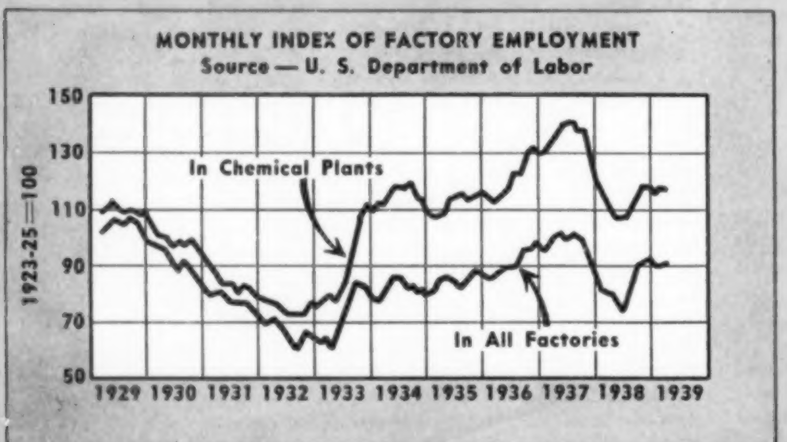
RESEARCH PAYS

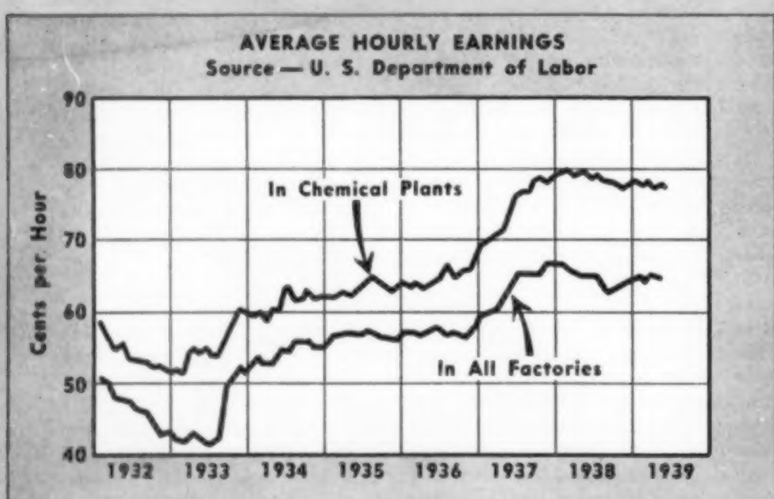
A study of 45 companies in chemical industry shows a remarkably consistent record of earning power, dividends and growth from 1929 through the depression to 1937. Thirty-nine of these companies had no deficits in any year. Earnings of the whole group in 1937 averaged 28 per cent above 1929. Thirty-eight paid cash dividends every year, averaging in 1932 only 5 per cent less than in 1929 and in 1937 over 90 per cent more than in 1929. In spite of these substantial disbursements, capital and surplus increased approximately 25 per cent over this period.

EMPLOYMENT IN CHEMICAL ENTERPRISE

Why wages are higher for shorter hours and under better working conditions than in most industries







EMPLOYMENT in chemical industry is safe, stable, and well paid. Most of the employees are well satisfied and labor troubles are rare. Working conditions have generally been made pleasant and favorable. Opportunity for such employment has grown steadily with enlargement of the industry. Individuals employed and society as a whole are therefore well served. These conclusions and many more are brought out by facts and statistical relationships presented in this chapter of "Facts and Figures".

Society is interested more in number of people at work and total dollars of payroll which they receive than in details of hours worked, wage rate maintained, or individual earnings. Society has been in these regards well served by the chemical enterprise of the United States, because the number of wage earners and the total payrolls have grown more steadily than in the rest of manufacturing.

Depressions affect chemical enterprise somewhat, but not so seriously as they do the average for all factory employment or payrolls. This is natural because chemicals are essential commodities for much of everyday living. Though largely used by other industry, and thus having industrial commodity significance, they take on also the characteristics of consumers' goods, because the things into which they go are among the every-day purchases of the average American.

Chemical enterprise is not quite so stable as some kinds of business, such as bread-baking and paper manufacturing. But the depression bottoms in number of workers and total of payroll were definitely higher than for most of the industrial community.

There has been more rapid progress and definitely more stable conditions in chemical plants than in the average for all factories. Hourly pay of chemical wage earners is not only higher than average for all factories, but also has been increasing more rapidly

Furthermore, the recovery from depression is quick and better maintained than the average for all industry. The result is that society finds the growth by chemical manufacturers was greater than all-factory growth by 40 to 50 per cent, comparing depression and post-depression averages in these official figures.

Individual wage earners are not so much concerned with these broad social trends. They are far more interested in the cents per hour and the hours per week of employment. Most of all, they are concerned with the average income per week and the buying power of that money. The hourly pay of chemical wage earners is not only higher than the average for all factories, but also has been increasing more rapidly in recent years.

The employment, in hours worked per week, has been much more constant in chemical plants than for all factories. There has been definite shortening of hours in times of slack business, but the total swing back and forth has been small.

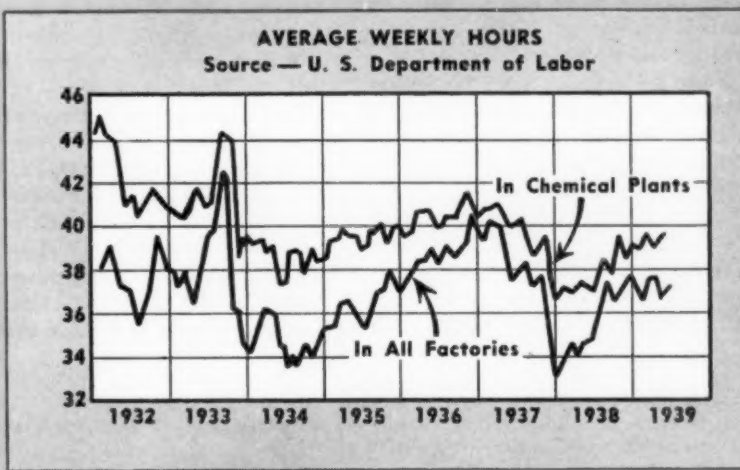
The buying power of the chemical worker has been even more constant and has grown more steadily than his weekly earnings. In times of depression prices are lower; and his somewhat lower weekly earnings have thus been adequate to procure larger quantity of wanted goods than the mere dollars might indicate. This smooths the growth curve and makes possible substantial progress which has been going on in post-depression years.

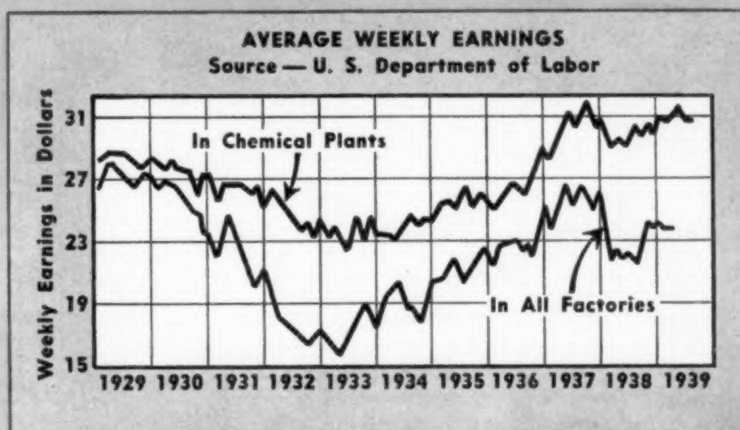
Chemical wage earners in the last few years have been able to buy with their weekly earnings about 25 per cent more in the way of housing, clothing, food, and other necessities and luxuries than they could buy in 1932. Their buying power is in fact greater, expressed in goods, than it was at the peak of the boom years 1928 and 1929, during which time the index of real wages never exceeded 107. The American chemical worker is favorably situated in his purchasing power compared with the corresponding employees of the other major nations of the world.

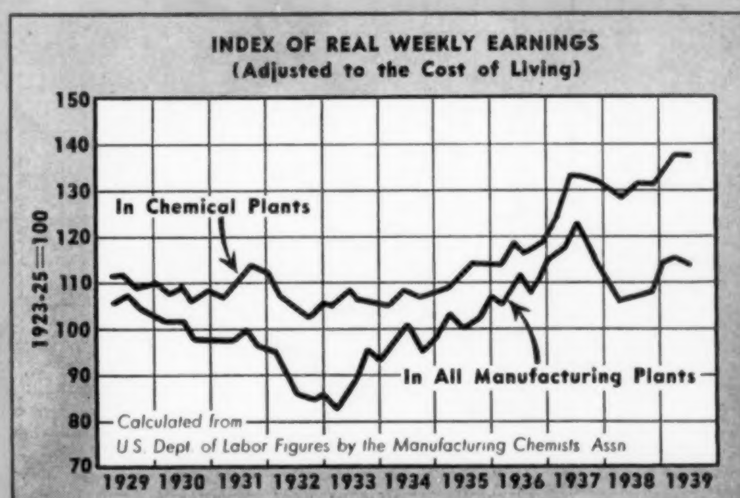
Chemical enterprise is intensely technical. Generally speaking, it needs highly skilled workers. It has relatively little need for large numbers of unskilled operators. In many cases safety alone demands that wage earners be alert and of high intelligence. These factors, of necessity, tend to force employment of better-than-average wage earners.

Under highly technical management, skilled wage earners are more profitable for the industry. These wage earners exercise their skill and maintain a self-disciplined high standard of work that is generally an advantage, frequently an absolute necessity, in chemical making. Hazard to fellow workers also is thus kept at a minimum.

Management of chemical enterprise is necessarily entrusted to technical







Weekly earnings in chemical plants have been both constant and higher than the all factory average. Buying power of the chemical worker has been even more constant and has grown more steadily than his weekly earnings

people. Those untrained in chemistry and engineering could not manage much of this business. Many of the jobs that in mechanical process industries can be filled by experienced men without special technical training are in chemical and chemical process industries necessarily assigned to men either of long training or more often to college graduates who have had professional education.

This technical influence of salaried workers extends to and affects the character of wage earners. In fact many of the wage earners after extended employment become virtually professional workers.

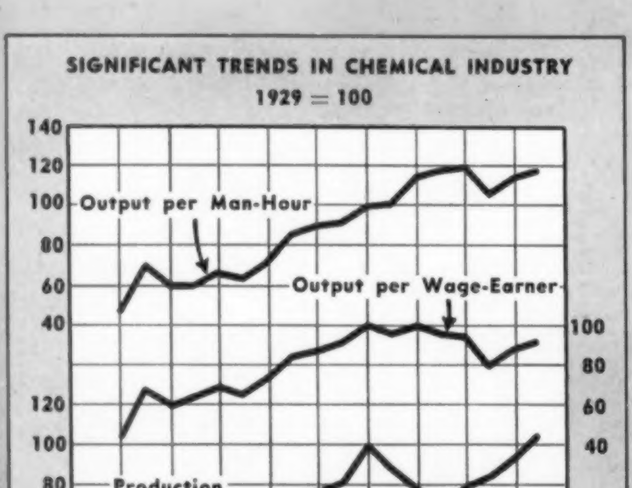
From the standpoint of the less-experienced or lower-paid workers there is an attraction, even for technically trained college men, in the employment of chemical enterprise. This results from the fact that these workers are afforded here an opportunity to advance through the ranks to management posts, which in chemical manufacture are commonly filled with technically trained men from the staff. Even the general executive management of most of the larger and middle-size chemical works is of this sort, professionally trained in science and chemical engineering, long engaged in this enterprise, managing on the basis of merit rather than on the basis of any mere business preference.

Chemical manufacturing is not highly seasonal although certain special commodities such as insecticides and anti-freeze chemicals, do respond to seasonal factors. Most of the changes which occur in it are in response to general business conditions. In fact, chemical usage is often cited as an index of business conditions. (See Chapter V). During 1937, for example, there was a steady rise in employment from about 75,000 workers to about 81,000 workers, until late in the year when the sharp business decline curtailed production activity. The fluctuation in chemical employment during that year was, in fact, almost exactly the same as the average for all manufacturing industries.

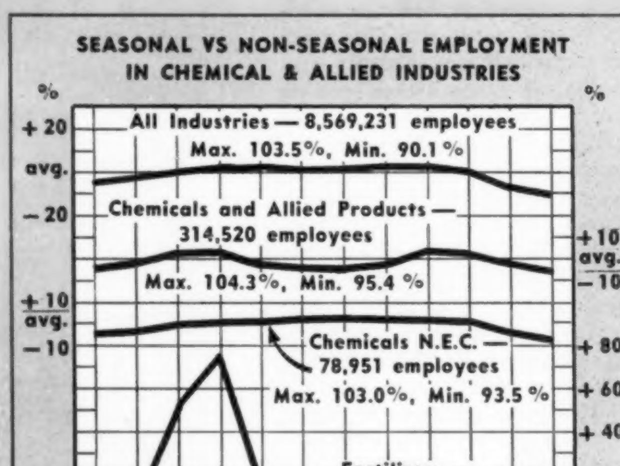
Many of the chemical process industries, on the other hand, do have distinct seasonal characteristics; as examples, the fertilizer and cottonseed crushing industries might be cited.

Growth of employment in chemical enterprise has been steady. In many cases it has been spectacular. Generally it has been the result of scientific research put to useful work by costly and skillful engineering development. (See Chap. II). Here it is important only to point out that research has not reduced the opportunity for employment. It has often decreased the number of man-hours required to produce a thousand units of product. But far more often research has created new products, established new uses for chemicals, or provided a basis for larger demand as a result of lower price. Taken together, the result has been much greater technologic *re*-employment or *new* employment, than any minor element of tech-

Among the significant trends in the chemical industry are: increase in output per man-hour, output per wage earner, production, employment and man hours



The chemical industry is not seasonal, but many of the process industries have distinct seasonal characteristics, for example, fertilizer and cottonseed crushing



nologic *un*employment in industry.

Furthermore, chemical employers have recognized constantly their responsibility to the individual and when a man's job has been destroyed by research, there has been constant effort to transfer that man to other employment on new products. The fact that the employees are of high average intelligence and adaptability has made this task less difficult than it would otherwise have been for such few cases as represented technologic unemployment.

Statistics are meager regarding the turnover of wage earners in the chemical industry as compared with other industries. Available figures for 1937 do not show the entire Census group, "Chemicals, n.e.c.", nor do they correspond with the Census totals for "All Manufacturing Industries". They do represent a good-size sample of each classification, however, and may be considered representative. For every 100 men employed in plants manufacturing chemicals, 33 left the company during the year. This compares with an average of 53 per 100 men employed in all manufacturing industries. New men were hired during the year, of course, and the figure for chemical industry was 27, indicating an employment of 94 men at the end of the year. Forty-three men were hired by the average manufacturing industry, but there were only 90 at the end of the year.

Of the 33 who left the chemical manufacturer, 3 were discharged, 19 were laid off, and 11 left of their own volition. Of the 63 who left the average manufacturing industry, 2 were discharged, 36 were laid off, and 15 made up their own minds to leave.

The money required to produce growth of chemical enterprise, and to increase opportunity for employment, has frequently come from within the industry itself. This has often been necessary because of the high cost of new chemical development and the high rates of depreciation on equipment which are essential with prudent chemical management.

It requires substantially more money invested in both working capital and fixed equipment and facilities to put a new wage earner to work in chemical enterprise than it does in average industry. A study by the National Industrial Conference Board for the Chemical Alliance brought out this fact in 1937. That study demonstrated that $11,250 was needed for each factory worker in chemical industry. For all manufacturing business the average is only $7,000 per wage earner. (See p. 544).

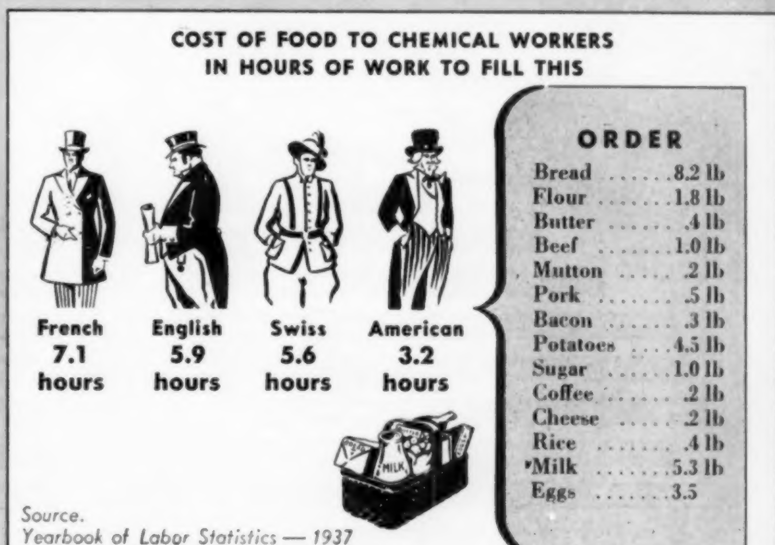
Of the new investment required in

Energy Cost per Worker

(Dollars per man)

	All industries	Chemicals and Allied products	Chemicals n. e. c.
Fuel cos	$957,000,000	$64,000,000	$35,400,000
Power cost	468,000,000	46,000,000	27,200,000
Total energy cost	1,425,000,000	110,000,000	62,600,000
Wage earners	8,569,000	315,000	79,000
Energy cost per worker	166	349	793

Source: 1937 Census of Manufactures, preliminary releases, May 11, 1939 and June 15, 1939.



The American chemical worker is favorably situated in his purchasing power compared with the corresponding employees of other major nations. The American worker is far more productive than workers in other parts of the world and achieves in his payroll greater buying power because of his high productivity

chemical manufacturing for new workers, nearly two-thirds is needed for new capital assets. These are the buildings, equipment, and other fixed facilities of production. About 36 per cent of the new money is working capital, needed for stocks of raw materials, goods in process, inventories, payrolls, and other operating purposes. Investors in chemical enterprise have found it profitable to put up these larger sums per worker because of the constant growth, the high efficiency, and the rapid capital turnover of this division of business.

One of the major reasons why high investments per man are justified in chemical enterprise is the fact that each worker has back of him a large energy supply to mechanize his work and to enlarge his productive efforts far beyond the level which could be reached by manual effort alone.

On the average for all industry, about $166 is spent per wage earner per year for fuel and power. This total energy cost per man is less than half of that for chemical and allied process industries, which purchase on the average $350 worth of energy per wage earner engaged. The makers of chemicals are still more generous in this regard. They spend on the average $792 per year per wage earner engaged. This is nearly five times as much as the average factory. Only a few industries like cement exceed this average of energy cost per wage earner employed.

The capacity of power equipment installed in most industrial establishments has been growing, but the makers of chemicals have not only supplied a higher horsepower per wage earner than other industries, but the growth has also been more rapid in recent years. The Census has not presented data of this character since 1929, but in that year the manufacturers of chemicals had 2.8 times the horsepower installed per man at work as did the average of all industry. Chemical process industry generally was better powered than all industry, but less highly mechanized than chemical manufacture, being about 1.7 times the average for all factories.

The value of goods made per wage earner employed is much higher in the case of chemical manufacturing than for the average of all factories. In 1937 the average sales realization of chemical works was $11,800 per wage earner. For process industry generally, it happens to be almost the same figure ($11,850). The average for all industry was only $7,090.

The ability of the chemical factory wage earner to produce larger dollar values in goods than do wage earners on the average, results from several considerations. Chemical plants are highly mechanized and include much expensive equipment. They use largely continuous processes, not batch operations. They require large supplies of electric energy and fuel. This increases the productivity of the worker. But of course it places a financial burden on the goods of greater capital cost to be carried and larger fuel and power bills to be met. Despite these burdens the chemical wage earner is far better paid than the average hourly employee of all American factories.

Salaried employees and technical workers play a larger part in chemical enterprise than in most industry. Even considering the workers at the point of production there are more supervisors and more clerical workers in either chemical manufacture or

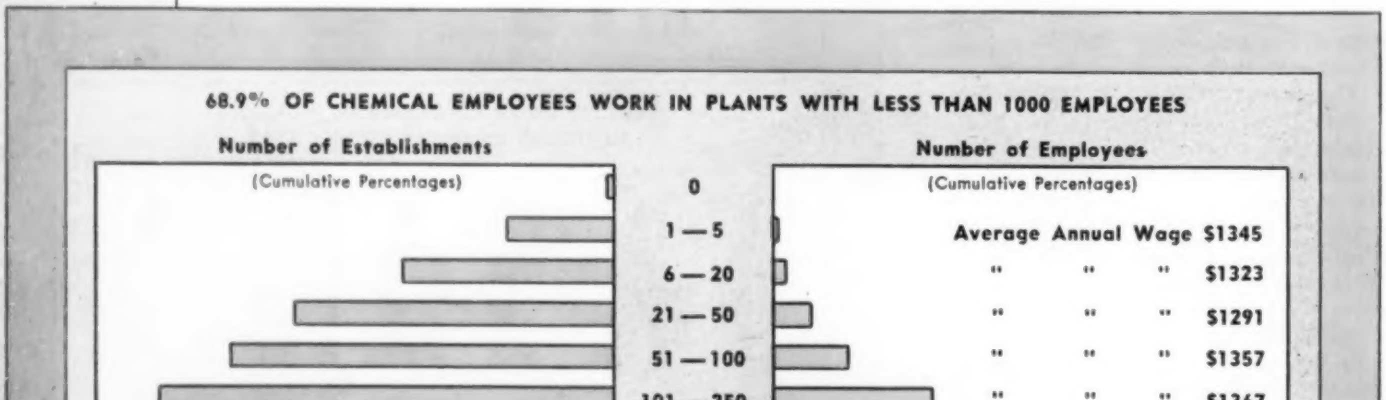
Installed Horsepower per Worker
(Hp. per man)

	All industries *	Chemicals and Allied Products *	Chemicals n. e. c. *
1929	4.85 hp. (100%)	8.22 hp. (170%)	13.75 hp. (283%)
1927	4.65 hp. (100%)	7.30 hr. (157%)	11.00 hp. (236%)
1919	3.25 hp. (100%)	5.22 hp. (160%)	6.25 hp. (192%)

* Per cent of all industry average for each census.

Source: 1929 Census of Manufactures.

Size of works in chemical manufacture varies widely, but a vast majority of chemical wage earners are engaged in plants that would be regarded as of medium size



process industry than in the average factory. Census figures show that for all industry 88 per cent of the workers are wage earners, but in both chemical manufacture and process industry only 82 per cent are of this class. In all kinds of industry, about 1 per cent of the persons employed in manufacturing are officers. And the plant-supervisory staff is only 3 per cent in the average industry, as in contrast with 5 per cent for process industry and 6 per cent in chemical making. Clerical workers constitute 8 per cent of the payroll, two-thirds of the salaried workers, in the average factory. But they are 11 or 12 per cent of the payroll in chemical and process industries.

If to these factory employees is added the general administrative, research, and sales groups an even more striking difference in chemical enterprise is found. In such technical business a large percentage have scientific or engineering training; even the sales personnel is largely so trained.

The size of works in chemical manufacture varies widely. But a vast majority of chemical wage earners are engaged in plants that would be regarded as of medium size.

In the United States big manufacturing plants usually pay a higher average wage than small ones. Of all factories reporting to the Census the average wage per worker ranges more or less steadily upward from $1,074 for the smallest establishments to $1,547 per worker for establishments employing more than 2,500 wage earners. It appears to be an advantage to the wage earner to work for a big firm, judging by these averages; but the factor of size of city and living costs must not be overlooked.

In the case of process industry the range is similar on the average. But the manufacturers of chemicals in each size group pay definitely a higher average wage than is found in the all factory averages. As a matter of fact, the minimum wage average for any size group in chemical manufacture is $1,291.

When one disregards size of establishment and compares merely average wages for all wage earners of the country, the following relationship develops: All industry average $1,180; process industry average $1,213; chemical manufacture average $1,485.

Safety for chemical workers has been developed to a high degree. Both the frequency of accidents and the severity of them have been reduced during recent years.

Chemical industry ranks far down the list of industries with labor difficulties. During the fiscal year 1937-38 (July 1, 1937-June 30, 1938), the U. S. Conciliation Service disposed of 4,231 situations involving 1,618,409 workers, and of that number only 47 situations involving 9,868 workers were classified industrially as chemical. During the first half of the fiscal year 1938-39 (July 1-December 31, 1938), this agency disposed fo 1,775 situations involving 746,152 workers with an average of 420 workers per case. For the same period, there were only 21 cases involving 3,176 workers disposed of in the chemical industry and these cases averaged only 151 workers.

Vacations with pay have been granted by some types of business for many years. But only in comparatively recent years, principally since the World War, has manufacturing industry provided vacations with pay for hourly wage earners. Employees of chemical enterprises have been among those earliest to receive these benefits.

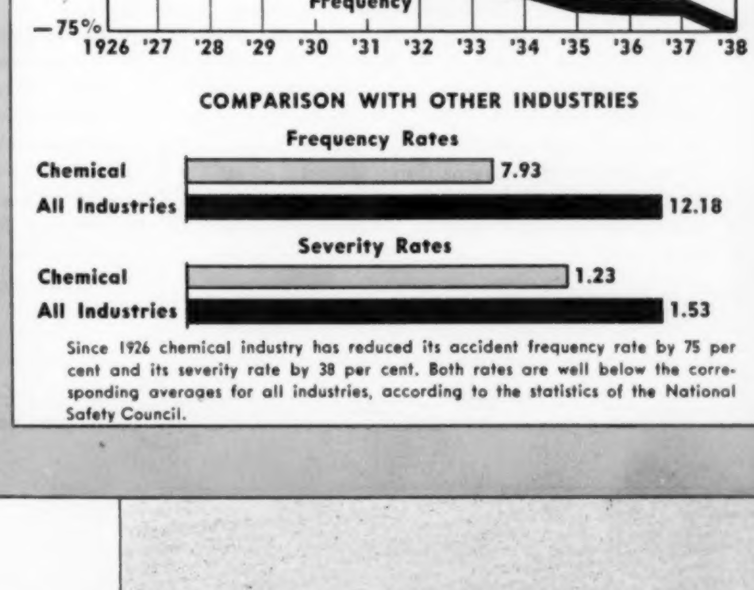
Other employee benefit plans have also been common under chemical managements. Pensions, profit-sharing, and various safeguards against financial hazard are now taken to be the expected thing in most divisions of process industry.

Labor Relations in Chemical Industry

(Strikes in 1937–38)

	All manufacturing Industry		Chemicals and Allied Products		Chemicals n. e. c.	
	1937	1938	1937	1938	1937	1938
Strikes	2,779	1,436	66	38	10	2
Workers involved	1,228,000	410,000	11,345	4,040	490	152
Man-Days idle	19,978,000	5,815,000	309,876	78,101	8,465	796
W.I. per strike	442	286	172.0	106.4	49.0	76.0
M.D.I. per strike	7,190	4,050	4,700	2,055	846	398
M.D.I. per W.I.	16.27	14.20	27.30	19.35	17.29	5.24

Source: Monthly Labor Review—May 1938 and May 1939, (Dept. of Labor).



Since 1926 chemical industry has reduced its accident frequency rate by 75 per cent and its severity rate by 38 per cent. Both rates are well below the corresponding averages for all industries, according to the statistics of the National Safety Council.

Safety for chemical workers has been developed to a high degree. Both frequency of accidents and severity of them have been reduced

WHAT BECOMES OF THE CHEMICAL DOLLAR?

The important part money plays in chemical industry is revealed by this analysis of income and outgo in their economic and social significance

CHEMICAL dollars, i.e., the money which is realized from the sale of chemicals, interest a lot of people. To those within the industry these are the dollars which provide them with jobs—that fill their pay envelopes and in addition must pay for the plants, equipment and materials with which they work. To those who have put their savings in its stocks and bonds, chemical dollars are the return on their investment—the rent on their savings. To management these dollars are the sole means of staying in business and of building the industry for the future. Receipts from sales are all that chemical industry has with which to meet payrolls, taxes, interest charges, to buy raw materials and machinery, to pay other current expenses, all in addition to setting up the reserves that are necessary if business is to continue to grow and prosper.

So there are many viewpoints from which we might proceed in making an analysis of the financial data for the chemical industry. In the past all too many of these analyses have been made by the banker, having in mind primarily the interest of the investor. Some excellent studies have resulted from the government's concern with taxes and other fiscal affairs, but none has fully analyzed the internal workings of the chemical industry itself. Too often the sample taken is neither representative nor comprehensive. In the government's compilations, it is common practice to classify extremely diverse enterprises as "chemical and allied industries." In the language of the stock market, "chemical" has even stranger significance.

Recognizing this situation as a common cause of confusion and the possible source of embarrassment to the industry itself, the editors of *Chemical & Metallurgical Engineering* arranged to have an impartial, critical study of the industry's financial data made by the National Industrial Conference Board. Many of the important figures revealed in this study are reported for the first time in this issue of "Facts and Figures of American Chemical Industry."

The results of the N.I.C.B. survey relate to the sales of about three-quarters of a billion dollars worth of

Following companies, each having assets over $10,000,000 were included in this study by W. P. A. for U. S. Securities and Exchange Commission.

Air Reduction Co., Inc.; Allied Chem. and Dye Corp.; The American Ag. Chem. Co. (of Del.); Atlas Powder Co.; Columbian Carbon Co.; Commercial Solvents Corp.; The Davison Chem. Corp.; The Dow Chem. Co.; E. I. du Pont de Nemours and Co.; Hercules Powder Co.; Interchemical Corp.; International Ag. Corp.; Monsanto Chem. Co.; Pennsylvania Salt Mfg. Co.; Tennessee Corp.; Union Carbide and Carbon Corp.; United Carbon Co.; U. S. Industrial Alcohol Co.; Virginia-Carolina Chem. Corp.; and Westvaco Chlorine Products Corp.

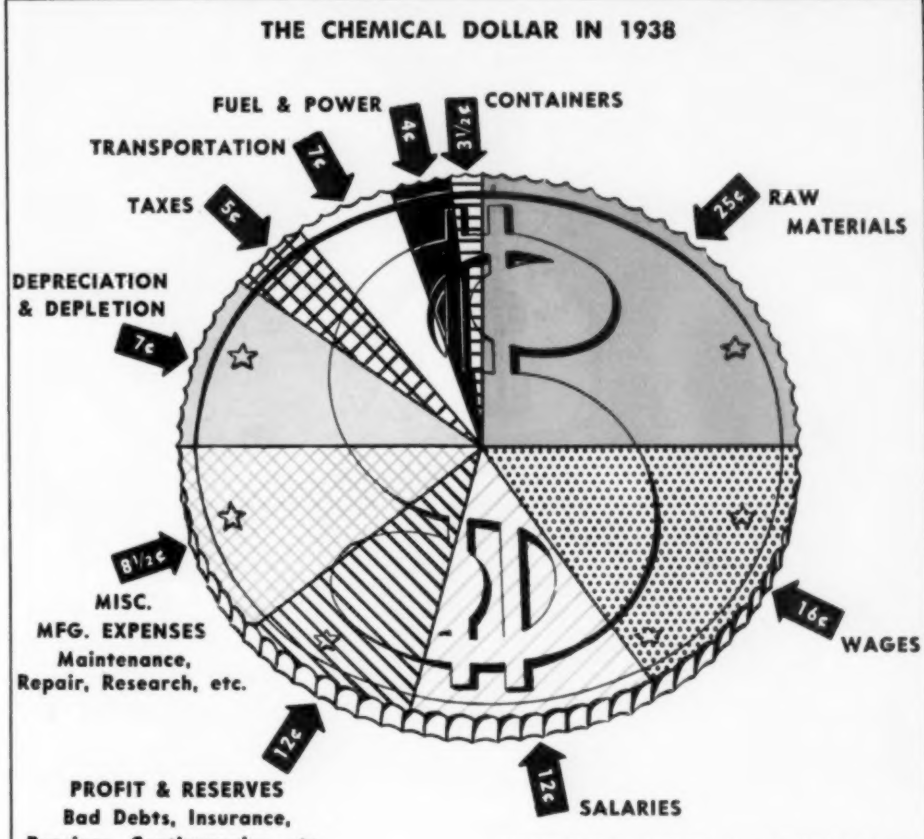
W. P. A. Project No. 16. June 1939.

COMBINED PROFIT AND LOSS STATEMENT for 20 Manufacturers of CHEMICALS AND FERTILIZERS FOR 1937

Production Cost	**54.6%**
Maintenance and Repairs	**5.4%**
Misc. Operating Items	**0.9%**
Sales, Admin., & Gen. Expenses	**12.9%**
Depreciation and Depletion	**5.4%**
Federal Income Taxes	**3.3%**
Other Taxes	**2.4%**
Interest Expense	**0.3%**
Net after all charges	**14.8%**
TOTAL SALES	**100.0%**
	OR $942,988,442

chemicals sold during the calendar year 1938 by 29 manufacturers. They are a representative cross section of the industry, including small and medium-sized companies as well as several very large ones. Following is a summary of the percentage distribution of the sales dollar as reported by these 29 firms:

1. Total sales realization in 1938	$746,495,169
2. Cost of Goods and Services purchased from others	48.3%
3. Wages and Salaries	27.8%
4. Reserves set aside for depreciation and amortization of fixed and intangible assets	7.0%
5. Taxes paid to Federal, State and Local governments....	4.8%
6. Gross Profits, including reserves set aside for bad debts, insurance, pensions, contingencies, etc.	12.1%
Total percentage of sales	100.0



SHOWING HOW $746,495,169 CHEMICAL SALES DOLLARS WERE SPENT BY 29 CHEMICAL MANUFACTURERS IN 1938

Source: National Industrial Conference Board, Special Report.

It is interesting to compare these figures with data collected by a recent W.P.A. project sponsored by the Securities and Exchange Commission and published in June, 1939. This report summarizes the more important statistics for about twenty large manufacturers of chemicals and fertilizers, each having assets of over $10,000,000 and registered under the Securities Exchange Act. The report covers the years 1934–37 inclusive and is remarkably complete.

Unfortunately from the standpoint of comparison with the N.I.C.B. figures, the S.E.C. study includes 4 or 5 companies that are concerned almost exclusively with the manufacture and sale of fertilizer. That industry, although closely related to chemical manufacture, does not always exhibit the same financial characteristics.

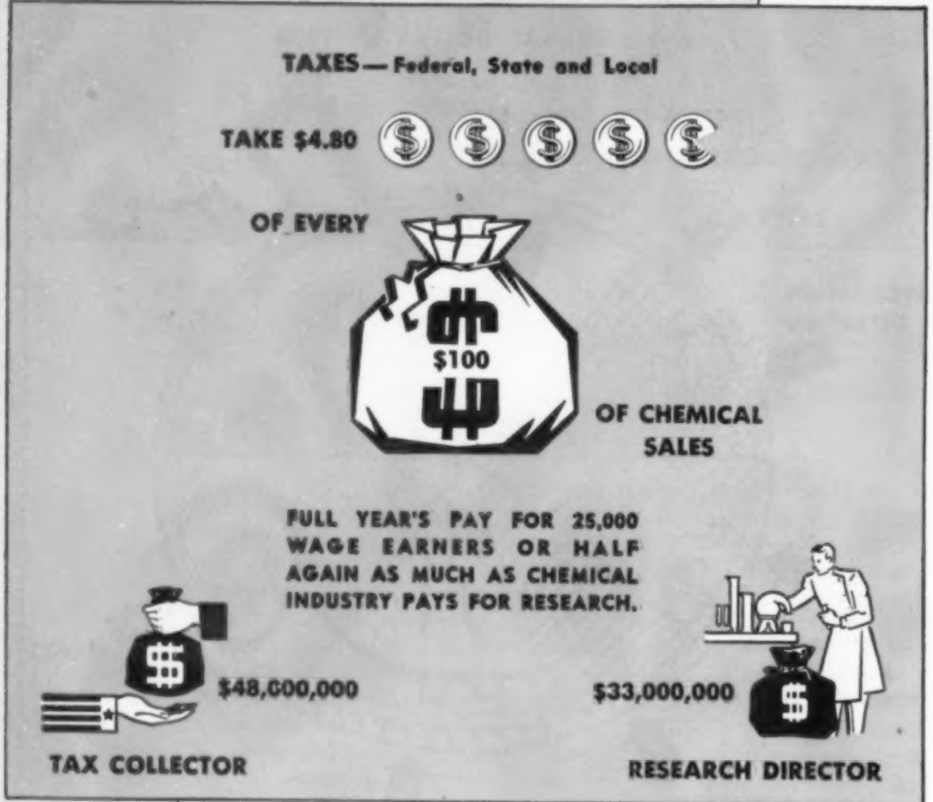
Major Cost Items

Returning now to the N.I.C.B. study, let us consider these items in their economic and social significance, as well as in their technical meaning to those who work in chemical industry. Among the major items of expenditure for the production of chemicals are those for raw materials, fuel and power, containers, and for payroll, both wages and salaries. Supplementing these cost-of-production items are the other charges for transportation, both of the raw materials and of the finished goods, the expenditures for research, selling expenses, and numerous forms of general expense, including management and insurance. Also to be paid from the chemical dollar are the large and growing assessments for taxes on real estate and on income and for the many other varied forms of local, state and federal taxation.

After all of these out-of-pocket payments have been made, there still remain, as obligations of the chemical dollar, the charges for depletion of reserves, the establishment of funds to care for contingencies, the provision for depreciation and obsolescence and the other types of capital charges which are just as truly expenses as are the spendings for payroll or for raw materials. Only after these charges have been covered does the chemical dollar begin to provide for interest or other return on the capital invested and for reward to ownership and management in the form of profit.

The results of the Conference Board analysis show that approximately 25 cents of the chemical dollar go for raw material. About 7½ cents go for fuel, power, and containers. Approximately 7 cents are needed to pay the transportation bills. Other charges on production that total about 9 cents are for maintenance and repairs, for research, and for miscellaneous manufacturing expenses. Without including any of the compensation for wage earners or salaried personnel, there is thus spent nearly half of the chemical dollar, to be exact, 48.3 cents.

Wages and salaries for the employees of chemical industry constitute the largest single item, requiring 27.8 cents of each chemical dollar. Of this expenditure for payroll, a very substantial share in the chemical industry goes for salaried personnel. No exact breakdown is possible, but a limited analysis using Census, Conference Board, and other figures shows that of the 28 cents spent for personnel, about 16 cents goes to wage earners and about 12 cents to salaried employees, including clerks, salesmen, scientific and engineering staffs, and management executives. In this regard the figures are different from



those commonly reported by the Census of Manufactures which include only the compensation paid to employees engaged in the manufacturing part of enterprise. The Conference Board figure includes all compensation whether the workers be in production, sales, management, or research.

It should not be overlooked in this connection that far more than this 27.8 cents goes for personnel services. A very large part of the raw material cost, most of the freight bill, a large share of the payment for fuel, power, and containers, really represent payroll spending of the concerns which supply materials or services to the chemical industry. This indirect wage bill is, in fact, probably nearly as great as the direct payroll charge of the industry itself. Certainly it would be easy to identify more than half of the total chemical dollar as necessary for direct wage payment to those engaged in the industry or in supplying it with goods and services.

Tax Records of Typical Companies in Chemical, Metallurgical and Process Industries for 1938

(Source: Congressional Record, July 19, 1939, pp. 13,303–5)

Name of company	Total assets	Total shares outstanding (common and preferred)	Total number stockholders (common and preferred)	Number of employees (1938 average)	Total taxes 1938 (all kinds)	Net income 1938 (after taxes)	Percent of taxes to net earnings before taxes	Taxes per common share, 1938	Dividends per common share, 1938	Taxes per common stock holder, 1938	Taxes per employee 1938
American Cyanamid Co.	72,034,323	2,825,179	19,000	7,700	1,880,152	2,452,912	43.4	.72	.60	[1] 98	244
American Rolling Mill Co.	138,849,766	3,318,575	42,858	14,582	2,453,506	[3] 1,307,880	214.2	.86	None	74	168
American Smelting & Refining Co.	164,108,100	2,691,669	28,119	28,734	6,600,000	10,611,809	38.3	3.01	2.25	322	230
Armstrong Cork Co.	53,306,870	1,462,660	9,109	[4] 8,673	1,105,595	1,150,796	49.0	.78	.75	122	127
Atlantic Refining Co.	199,058,436	2,811,999	34,041	11,816	[5] 5,318,827	4,317,297	55.2	2.00	1.00	181	450
Atlas Powder Co.	24,617,729	317,760	4,464	[4] 2,225	512,051	1,013,056	33.6	2.06	2.25	164	230
Bethlehem Steel Corporation	699,474,044	5,051,758	74,358	82,680	13,183,148	5,250,239	71.5	4.14	None	278	159
Celanese Corporation of America	60,958,060	1,312,997	8,363	8,443	1,309,245	2,479,749	34.6	1.31	None	245	155
Certainteed Products Corporation [2]	20,269,385	698,400	6,569	2,615	361,279	171,010	67.9	.58	None	78	138
Cities Service Co. [2]	1,080,068,703	4,635,739	622,000	24,000	17,940,158	5,814,515	75.5	4.84	None	35	748
Colgate-Palmolive-Peet Co.	74,867,801	2,195,905	17,383	10,000	7,119,671	4,921,921	59.1	3.63	.25	664	712
Commercial Solvents Corporation [2]	21,255,955	2,636,878	29,024	1,120	[6] 15,892,689	[3] 294,358	101.9	6.03	None	548	14,190
Container Corporation of America	25,222,126	781,253	8,017	4,000	472,977	29,470	94.1	.61	.30	50	118
Corn Products Refining Co.	113,227,947	2,780,000	19,843	4,473	2,938,285	9,753,669	23.2	1.16	3.00	172	657
Crown-Zellerbach Corporation	104,550,172	2,790,854	22,700	8,300	[7] 2,650,000	6,211,414	29.9	1.17	.75	189	319
Diamond Match Co.	34,044,382	1,300,000	8,784	5,265	1,728,289	2,073,862	45.4	2.47	[8] 1.25	259	328
Du Pont de Nemours & Co.	810,543,555	12,640,110	76,535	42,300	13,020,000	50,190,827	20.6	1.18	3.25	218	308
Eastman Kodak Co.	177,061,899	2,312,578	38,851	23,800	7,228,000	17,339,408	29.4	3.21	6.00	193	304
B. F. Goodrich Co.	132,008,377	1,715,287	26,480	20,000	7,300,000	2,240,119	76.5	5.60	None	362	365
Hercules Powder Co.	46,992,039	1,412,904	6,680	5,137	1,332,930	3,089,017	30.1	1.01	1.50	312	259
Johns-Manville Corporation	51,056,564	925,000	7,752	9,838	1,474,664	1,455,302	50.3	1.73	.50	[1] 190	150
Libbey-Owens-Ford Glass Co.	45,327,176	2,509,750	13,572	5,209	1,464,916	3,930,460	27.2	.58	1.25	108	281
Masonite Corporation	5,919,281	557,629	2,550	1,700	450,535	1,144,274	28.3	.84	1.50	215	265
Monsanto Chemical Co.	66,737,903	1,341,816	11,286	5,737	[6] 2,640,593	3,290,519	44.5	2.13	2.00	311	460
National Gypsum Co.	16,370,377	1,321,458	6,023	1,785	407,249	921,632	30.6	.32	None	88	228
Owens-Illinois Glass Co.	85,057,974	2,661,204	9,212	[4] 13,901	2,333,626	5,383,805	30.2	.88	1.50	253	168
Parker Rust-Proof Co.	2,438,910	432,225	3,279	90	157,780	575,738	21.5	.37	.875	49	1,753
Pure Oil Co. [2]	180,363,078	[9] 4,703,450	[9] 40,000	[9] 7,200	[6] 31,956,203	5,412,903	85.5	8.03	None	1,102	4,438
Republic Steel Corporation	348,715,525	6,234,757	59,045	42,073	5,548,309	[3] 7,997,825	....	.95	None	114	132
Ruberoid Co.	15,593,759	397,806	1,230	2,500	354,131	515,472	40.7	.89	.60	288	142
Shell Union Oil Corporation	399,399,214	13,411,725	20,266	25,547	[6] 77,316,796	11,318,423	87.2	5.92	.70	4,445	3,026
Socony-Vacuum Oil Co.	923,438,918	31,206,071	113,240	56,429	[6] 116,475,818	40,106,917	74.4	3.73	.50	1,029	2,064
Standard Oil Co. of Indiana	724,663,142	15,272,020	99,665	[4] 29,928	[6] 97,485,205	27,771,976	77.8	6.38	1.00	978	3,257
Sun Oil Co.	139,139,150	2,416,484	7,223	13,320	[6] 34,375,564	3,085,119	91.8	14.84	1.00	6,578	2,581
Texas Corporation	605,360,644	10,876,882	86,380	30,717	[3] 104,357,013	23,139,030	81.9	9.50	2.00	1,208	3,397
Texas Gulf Sulphur Co.	61,097,347	3,840,000	30,741	850	2,771,000	6,963,633	28.5	.72	2.00	90	3,260
Tide Water Associated Oil Co.	202,758,519	6,875,253	29,416	10,652	[3] 33,443,619	10,427,273	76.2	5.24	1.00	1,386	3,140
Union Bag & Paper Corporation	19,373,390	1,052,274	2,667	3,713	511,921	903,892	36.2	.49	.125	192	138
Union Oil Co. of California	165,993,365	4,666,270	26,524	9,580	[6] 16,109,450	6,862,758	70.1	3.45	1.20	607	1,682
United Carbon Co.	30,240,309	397,885	3,943	656	747,912	1,505,874	33.2	1.88	3.25	190	1,140
United Gas Improvement Co.	837,616,393	[1] 24,017,226	[1] 127,974	13,086	15,439,841	26,832,668	36.5	.66	[1] 1.00	144	1,180
United States Steel Corporation	1,711,279,005	12,306,063	219,727	202,108	48,842,131	[3] 7,717,454	118.8	5.61	None	290	242

[1] Per stock holder (common and preferred). [2] Includes subsidiaries. [3] Deficit. [4] As of Dec. 31, 1938. [5] $24,194,4o8 excise taxes not included. [6] Excise taxes included constitute considerable portion of total. [7] Includes $427,700 Canadian taxes. [8] Plus $2.50 in securities. [9] For parent company only.

Taxes—The expenditures of the chemical industry for taxes have steadily grown as they have for industry in general. In 1938 the direct taxes of chemical manufacturers were about 4.8 cents out of each chemical dollar according to the N.I.C.B. study. This means that the tax collector takes 1½ times as much as does the research department, despite the fact that chemical industry does more research than any other type of manufacturing industry. And the tax bill exceeds the bill for fuel and power, although this industry is one of the greatest users of energy.

It is interesting to note that the taxes paid by the chemical industry would pay the wages of about 25,000 additional workers at the typical high wages of this industry. If spent for payroll instead of taxes, this would represent approximately a 20 per cent increase in the direct employment of wage earners by the chemical manufacturing industry.

An interesting analysis of taxes paid by industry was made by Dun and Bradstreet and published in ***Dun's Review*** for July 1939. This analysis included 116 firms which are reported to manufacture "industrial chemicals and chemical products" (sic.). The taxes paid by these firms in 1938 amounted to 3.13 cents per dollar of aggregate sales. This compared with 3.62 cents per dollar is the total tax payment for all manufacturers, excluding manufacturers of alcoholic beverages, petroleum products and tobacco products.

Another interesting analysis was prepared by Charles A. Segner for "Investor America" (see *Congressional Record*, July 19, 1939, pp. 13302 ff.). This survey covered 163 manufacturing concerns in the United States, having $40,000,000,000 in assets, 6,500,000 stockholders and approximately 3,000,000 employees. The averages for these 163 companies were as follows:

Percentage of taxes to net earnings before taxes....... 61.60
Taxes per share, 1938........$ 2.73
Dividends per common share, 1938 ....$ 1.33
Taxes per common stockholder, 1938 ....$283.00
Taxes per employee, 1938......$576.00

Included among these 163 companies were eight representative chemical manufacturers. The tax averages for these eight chemical concerns were as follows:

Percentage of taxes to net earnings before taxes...... 41.50
Taxes per common share, 1938 $ 2.13
Dividends per common share, 1938 .... $ 2.20
Taxes per common stockholder, 1938..................$242.00
Taxes per employee, 1938....$2407.00

One must not conclude from the foregoing that taxes on chemical enterprise are much less than the average for all industry. The percentage of taxes to net earnings are less be-

Comparative Fuel and Power Cost

	All Industries	Chemicals and Allied Products	Chemicals n.e.c.
Fuel cost	$957 million	$64.2 million	$35.4 million
Power cost	468 million	46.0 million	27.2 million
Total energy	1,425 million	110.2 million	62.6 million
No. establishments	166,794	7,419	601
Energy cost/estab	$8,500	$14,850	$104,000
*(Value of Products	$60,713 million	$3,722 million	$933 million)
Energy cost per $Val. of Prod	2.35¢	2.96¢	6.71¢

* Source: U. S. Census of Manufactures, 1937.

Sources of Industrial Energy

	All Manufacturing Industries		Chemicals and Allied Prod.		Chemicals n.e.c.	
Coal: (short tons)						
Anthracite	6,561,820	100%	604,535	9.20%	280,462	4.27%
Bituminous	162,960,976	100	9,913,593	6.08	5,043,533	3.09
Coke (short tons)	42,194,064	100	458,509	1.08	386,159	0.92
Fuel Oil (bbl.)	136,255,044	100	8,891,540	6.52	4,627,004	3.39
Gas (Million cu.ft.)	2,825,974	100	115,191	4.08	50,365	1.78
Electricity (1000 KWH)*	45,924,221	100	9,553,975	20.8	7,885,849	17.16
Establishments	166,794	100	7,419	4.45	601	0.36
Wage Earners	8,569,231	100	314,520	3.67	78,951	0.92
Value of Products	$60,713 mil.	100	$3,722 mil.	6.13	$933 mil.	1.53

* Purchased electric energy only; does not include electric energy generated in manufacturing plants
Source: U. S. Census of Manufactures, 1937. (Preliminary Releases of May 11 and June 15, 1939).

FUEL AND POWER COSTS ARE HIGHER IN CHEMICAL INDUSTRIES

	COAL 	POWER 	TOTAL COSTS 
ALL INDUSTRIES (Ave)	1.58	0.77	2.35
Chemical and Allied Ind.	1.72	1.24	2.96
Chemicals n.e.c.	3.79	2.92	6.71
Glass	5.44	1.44	6.88
Salt	7.03	0.76	7.80
Cement	13.62	5.13	18.75
Compressed Gases	0.64	5.41	6.05
Fertilizers	0.42	0.89	1.32
Pulp & Paper	4.54	1.62	6.16
Soap	0.93	0.20	1.13

All figures in cents per dollar of product value

Source: U. S. Census of Manufactures for 1937

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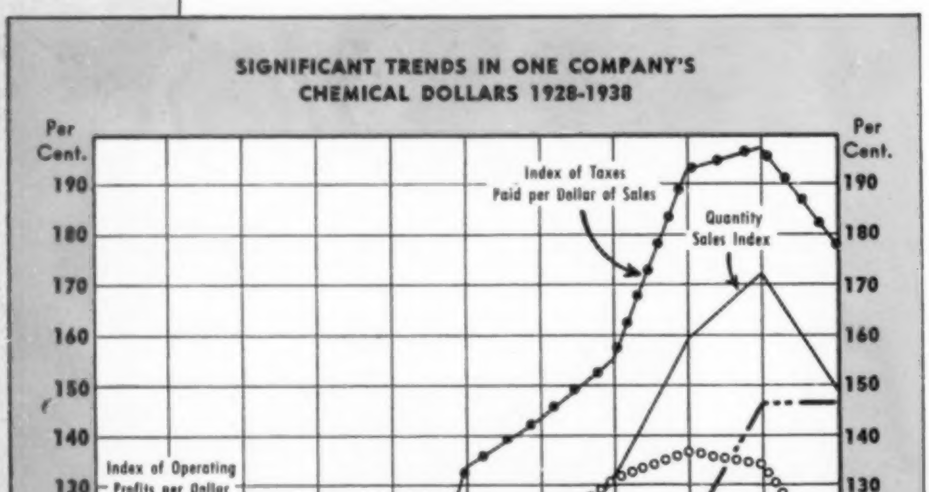
* In commenting on this apparent discrepancy between the N.I.C.B. and Census figures, one chemical manufacturer points out that several of the companies included in the former study may generate their own power from purchased coal or that mined on their own properties. In such cases, wages and salaries used in making this power may have been reported as cost of labor rather than of fuel and power. The significant fact, however, is that the chemical manufacturer is a much larger user of fuel and power than the average industry.

Assets of Twenty American Chemical and Fertilizer Companies

(As shown in Combined Balance Sheet prepared for Securities and Exchange Commission by W.P.A. Project, June 1939.)

Item	On or about Dec. 31, 1937 Amount	% of total	On or about Dec. 31, 1936 Amount	% of total	On or about Dec. 31, 1935 Amount	% of total	On or about Dec. 31, 1934 Amount	% of total
Cash and cash items	141,603,850	8.5	171,887,472	11.0	151,140,617	10.1	131,265,166	9.1
Marketable securities	108,004,941	6.6	72,063,773	4.6	103,165,104	6.9	101,966,076	7.1
Trade receivables*	77,332,573	4.6	93,040,942	5.9	78,313,878	5.2	67,606,377	4.7
Inventories*	220,064,650	13.2	179,381,872	11.4	167,728,143	11.2	161,356,319	11.2
Other current*	5,802,250	.3	5,660,900	.4	11,223,477	.7	3,358,295	.3
Total current assets*	552,808,264	33.2	522,034,959	33.3	511,571,219	34.1	465,552,233	32.4
Funds earmarked for long-term debt due in one year	0	.0	0	.0	0	.0	0	.0
Investment in affiliates*	29,049,089	1.7	27,402,494	1.7	21,621,786	1.4	22,872,399	1.6
Other security investments*	253,013,349	15.2	246,138,513	15.7	230,661,066	15.4	235,170,768	16.4
Other non-security investments*	3,622,106	.2	1,352,195	.1	1,529,706	.1	1,564,610	.1
Other investments not segregated*	827,203	.1	1,065,264	.1	1,107,168	.1	655,691	[a]
Total investments*	286,511,747	17.2	275,958,466	17.6	254,919,726	17.0	260,263,468	18.1
Treasury stock — registrant	9,945,272	.6	6,530,327	.4	5,487,823	.4	5,913,462	.4
Treasury bonds — registrant	335,456	[a]	1,090,525	.1	541,799	[a]	453,379	[a]
Treasury securities — subs. cons.	0	.0	0	.0	0	.0	0	.0
Total treasury securities	10,280,728	.6	7,620,852	.5	6,029,622	.4	6,366,841	.4
Land, buildings and equipment*	744,620,770	44.6	686,128,248	43.8	653,206,110	43.5	628,620,988	43.7
Intangibles*	61,733,949	3.7	61,801,078	4.0	62,306,470	4.1	61,643,925	4.3
Deferred charges	8,908,493	.5	8,426,508	.5	7,442,861	.5	6,721,011	.5
Other assets*	3,367,392	.2	4,845,119	.3	6,155,996	.4	8,751,795	.6
Total assets*	1,668,231,343	100.0	1,566,815,230	100.0	1,501,632,004	100.0	1,437,920,261	100.0
Reserves deducted above:								
For current assets	8,441,187	....	7,271,841	....	8,566,409	....	8,425,041	....
For investments	558,489	....	1,981,667	....	2,019,259	....	1,962,610	....
For land, buildings and equipment	542,014,843	....	508,015,429	....	475,611,152	....	441,094,757	....

* After reserves—unless company carried valuation reserves as liabilities
[a]—Denotes less than 1/20 of 1 per cent



cause chemical earnings are somewhat higher than average, as is shown by the comparative dividends. Chemical securities are more widely held than the average for all industry. Taxes per employee are much higher because there are relatively fewer wage earners and in addition to the usual real estate and income taxes, chemical industry must often pay excise, mineral extraction and other special taxes.

Fuel and Power — Expenditures for fuel and power amount to about 4 per cent of sales according to the N.I.C.B. study. This compares with 2.35 per cent of the value of products reported for all industries in the 1937 Census of Manufacturers, 2.96 for "Chemical and Allied Products", and 6.71* per cent for the more limited classification of "Chemicals, n.e.c." The latter group in 1937 had a fuel and power bill of approximately $62,600,000.

Capital Obligations

The investment of capital for chemical manufacture is high. This is a highly technical division of industry. As explained earlier in this issue (see page 543) it requires nearly 50 per cent more money to put a wage earner to work in a chemical plant than in the average factory. The investment so made for chemical manufacturing is, moreover, of relatively short life. This is due not, as many believe, to the highly corrosive nature of the chemicals handled. It is far more the result of rapid change in methods and machinery made necessary by the rapid advances and the new techniques which constantly come from the research laboratories of the industry.

Probably no other division of American enterprise is compelled to retire as large a percentage of its capital investment annually as is the chemical maker. It is not infrequently the case that machinery for new processes must be written off at the rate of 33 per cent or more per year in order that still newer developments may take the place of present improvements when existing machinery is but a few years old. Typically the rate for depreciation and obsolescence on chemical process equipment is from 20 to 33 per cent per year (see *Chem. & Met.* Feb. 1938 p. 80 ff). In other words, a 3 or 5 year life is all that can be assumed for much of this investment.

Because of the high capital invest-

*See tables, chart and special footnote on p. 561.

ment and rapid rate of retirement, the burden on the chemical dollar for depreciation and obsolescence is high. The Conference Board study above referred to indicates that 7 cents of each chemical dollar are so used and it should not be forgotten that this allotment is not merely a bookkeeping charge. It is an actual setting aside of money that is going to be spent just as truly as is the money that goes for freight, fuel or payroll. It has been aptly said, however, that "the scrap piles of obsolete industrial equipment are the stairs on which society climbs to an ever higher standard of living."

22 REPRESENTATIVE CHEMICAL COMPANIES SPENT $19,862,740 IN 1938 FOR RESEARCH OUT OF $609,685,606 OF TOTAL SALES OR

3.3%

According to special study of National Industrial Conference Board

Organic Chemical Industries spend nearly	**5.0%**
Heavy Chemical Industries spend about	**2.0%**
All Industry spends an estimated average of	**0.2%**

RESEARCH IS A MEASURE OF TECHNICAL PROGRESS

Reward to Owners

Chemical enterprise is typically a business of relatively stable profits. This may seem odd in view of the highly hazardous nature of the investment, considered from the standpoint of frequent retirement. But if the chemical maker cannot operate on a basis that would permit a rapid turnover of both capital and goods, he is quickly outdistanced by his competitors. The price charged for the chemical must be sufficient to cover these expenses and to leave something over for the investor. Were this not the case, the investor could be expected to retire from the business and the industry would shrink or at least become unable to take advantage of the new developments which come from its research and development work.

A prominent banker says, "Chemical research has made old-fashioned banking the most highly hazardous business in the world." In other words, analysis of the balance sheet is no longer the sole criterion of chemical prospects. It also explains why chemical enterprise must reinvest part of its earnings in its own business in order to grow. It could not induce its capital from without to sustain all of the new investment, much of which is, in truth, speculative.

The Conference Board studies indicate that less than 12 cents of each dollar are needed as the reward to capital invested and for the payment to management and owners for the risk which they take in maintaining a business so rapidly shifting in its many technical characteristics. This item is included along with the reserves for bad debts, insurance, pensions, contingencies and so forth, in what one might perhaps best call "gross profit". This is the money that pays the interest on bank borrowings, the interest on bonds, the dividends on preferred and common stock, and provides the earned surplus from which much new investment is commonly made. Of course the larger part of the total is merely the return on the capital investment—the "rent" on the savings of its investors.

The reward to capital and the reward to workers are the two most important social and economic factors of any industry. It is interesting to note that in chemical manufacture 2 1/3 times as much goes for direct payroll as for capital and ownership reward combined.

Spending for the Future

New advances and achievements of chemical industry have been described and their social implications explained in earlier chapters. Most of the progress there reported comes from research done by the industry itself. About 3.3 cents of each chemical dollar are so spent. Perhaps it would be better to say this amount is invested, because the result is new knowledge, new opportunity, new methods and machinery from which enlarged business and greater public service can develop.

Liabilities of Twenty American Chemical and Fertilizer Companies

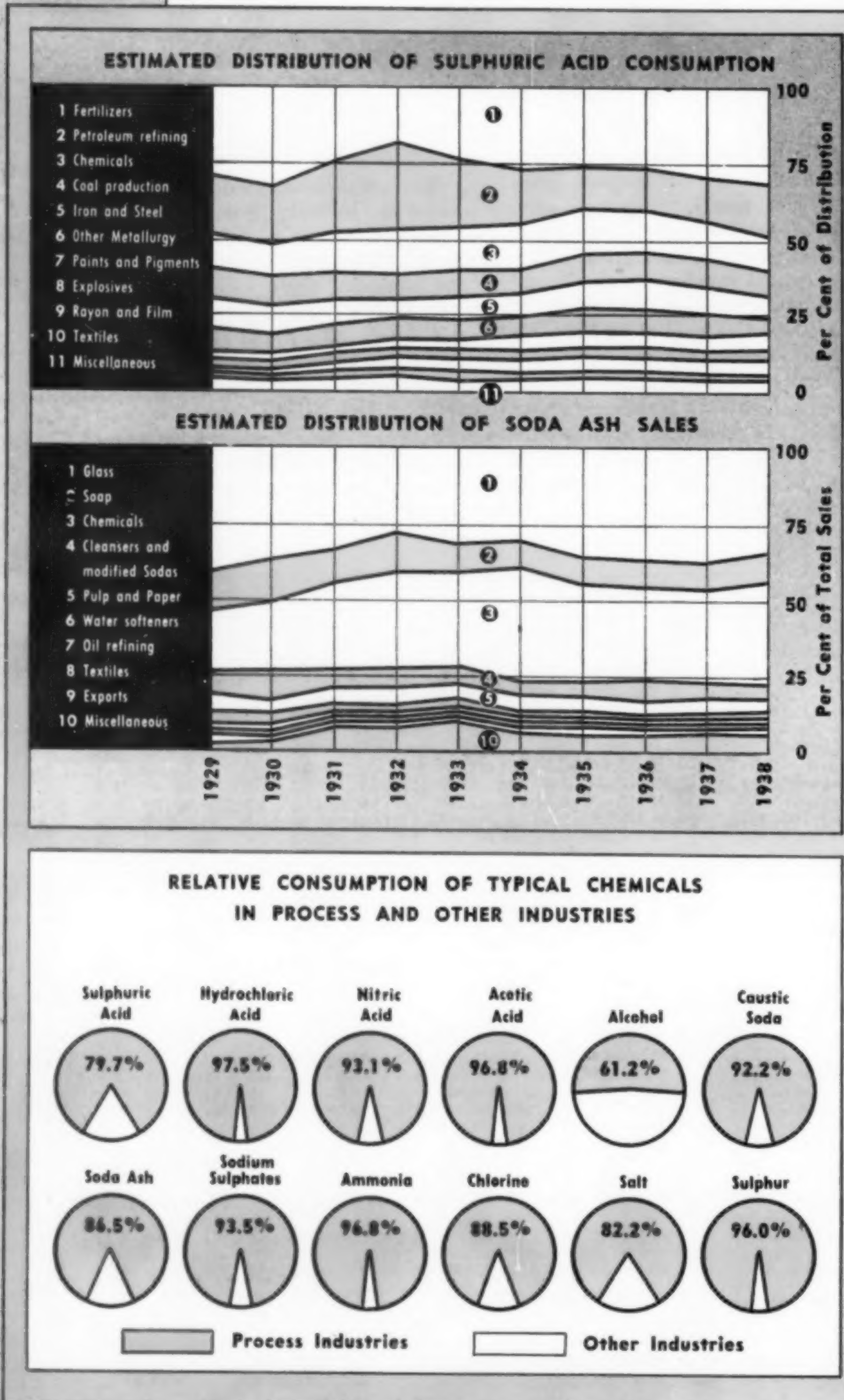
(As shown in Combined Balance Sheet prepared for Securities and Exchange Commission by W.P.A. Project, June 1939.)

Item	On or about Dec. 31, 1937 Amount	% of total	On or about Dec. 31, 1936 Amount	% of total	On or about Dec. 31, 1935 Amount	% of total	On or about Dec. 31, 1934 Amount	% of total
Notes payable	4,435,000	.3	1,535,000	.1	1,750,000	.1	800,000	a
Accounts payable — trade	24,537,045	1.5	28,628,680	1.8	21,685,732	1.5	20,169,300	1.4
Accrued items	51,417,318	3.1	50,901,668	3.3	33,320,249	2.2	24,925,106	1.7
Other current liabilities	20,679,865	1.2	18,998,911	1.3	16,316,531	1.1	14,340,128	1.0
Total current liabilities	101,069,228	6.1	100,064,259	6.5	73,072,512	4.9	59,934,534	4.1
Bonds, notes and mortgage instalments due in one year	1,870,000	.1	2,535,000	.1	1,320,000	.1	844,089	1
Deferred income	73,703	a	183,151	a	305,949	a	259,253	a
Funded debt	32,889,100	2.0	35,799,000	2.3	30,763,400	2.0	19,596,900	1.4
Non-current debt to affiliates	3,189	a	16,269	a	7,318	a	9,099	a
Other long-term debt	4,079,380	.2	3,278,316	.2	7,377,138	.5	4,290,000	.3
Total long-term debt	36,971,669	2.2	39,093,585	2.5	38,147,856	2.5	23,895,999	1.7
Other liabilities	31,145,074	1.9	26,369,920	1.7	22,015,849	1.5	20,662,227	1.4
Valuation reserves — for fixed assets	337,668	a	558,120	a	552,177	a	1,017,436	.1
Valuation reserves — other	40,034,981	2.4	40,224,253	2.6	40,226,157	2.7	40,484,558	2.8
Other reserves	37,716,879	2.3	37,915,386	2.4	36,880,128	2.5	32,942,777	2.3
Total reserves	78,089,528	4.7	78,697,759	5.0	77,658,462	5.2	74,444,771	5.2
Minority interest	5,328,156	.3	5,420,308	.3	5,145,874	.3	11,323,003	.8
Preferred stock	233,074,207	14.0	175,092,407	11.2	205,707,707	13.7	213,422,295	14.8
Common stock	571,593,942	34.2	567,733,591	36.2	566,483,579	37.7	564,968,655	39.3
Total stock	804,668,149	48.2	742,825,998	47.4	772,191,286	51.4	778,390,950	54.1
Capital surplus	121,490,604	7.3	118,362,012	7.6	73,857,057	4.9	75,724,531	5.3
Earned surplus	487,525,232	29.2	453,263,238	28.9	437,917,159	29.2	392,440,904	27.3
Total surplus	609,015,836	36.5	571,625,250	36.5	511,774,216	34.1	468,165,435	32.6
Total capital stock and surplus	1,413,683,985	84.7	1,314,451,248	83.9	1,283,965,502	85.5	1,246,556,385	86.7
Total liabilities	1,668,231,343	100.0	1,566,815,230	100.0	1,501,632,004	100.0	1,437,920,261	100.

a—Denotes less than 1/20 of 1 per cent

CHEMICAL MARKETS AND

Downward trends of prices and the development of new products within the industry, coupled with the creation of new consuming outlets and the enlargement of old ones outside the industry, are important factors in the increasing production of chemicals.



DEVELOPMENTS, in recent years, of new chemicals and of new products for which chemicals are essential raw materials, is establishing the chemical industry on a plane where its importance becomes progressively more important. Mention of rayon, cellophane, plastics, and lacquers is sufficient to typify instances where new manufactures have come into being as the result of chemical progress and conversely chemical progress has been stimulated by the broader market for materials which these new industries have created. The result of applied research in the older consuming lines also generally has a direct influence on distribution of chemicals as is exemplified in the case of the expansion of kraft paper production in the southern states.

Many industries go back to 1929 as their year of peak output but reference to Census data reveals that such basic chemicals as soda ash and caustic soda in 1937 surpassed their 1929 records by more than 13 per cent and 26 per cent respectively. The growth of synthetic organic chemicals of non-

ESTIMATED DISTRIBUTION

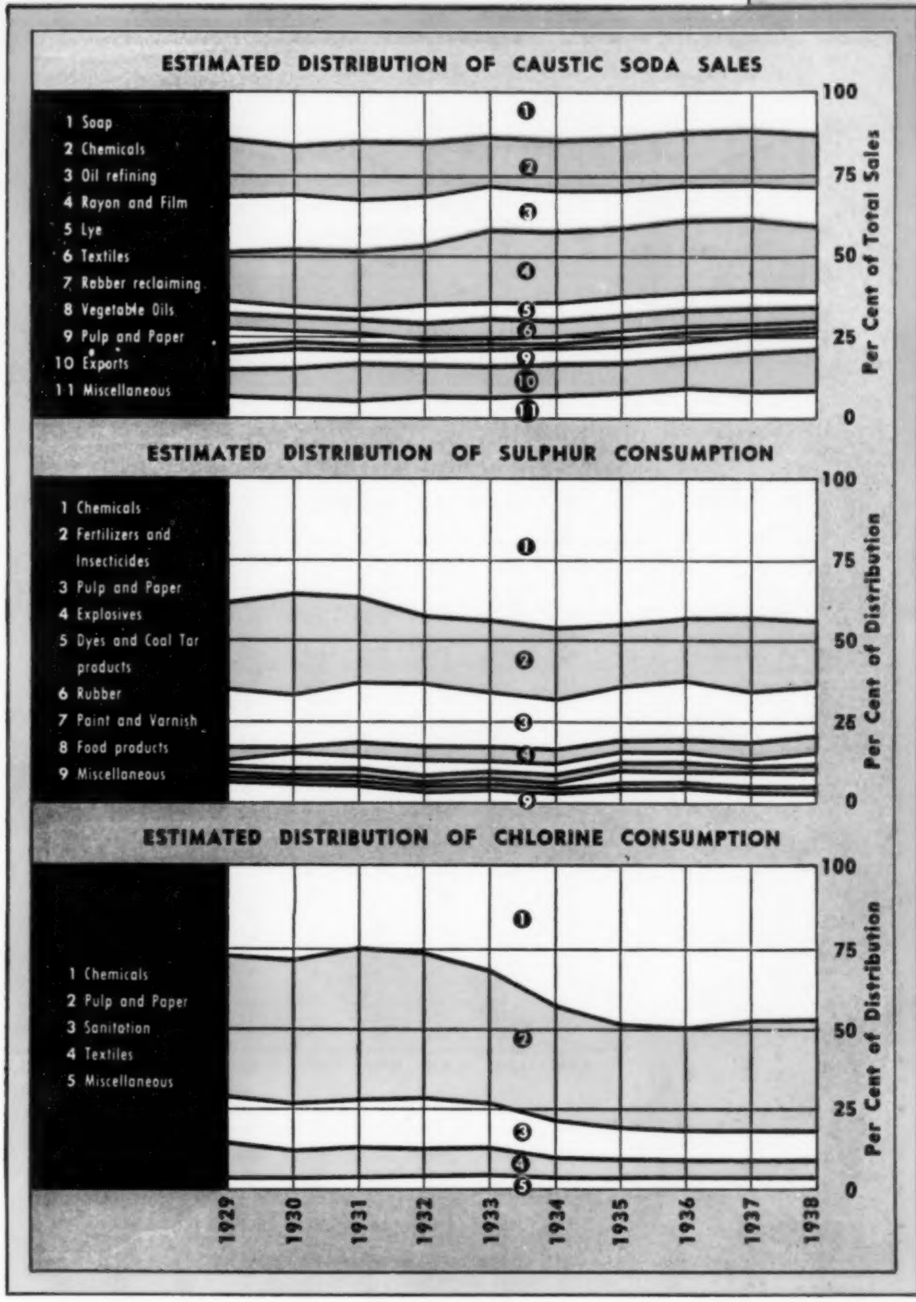
Consuming Industries	Sulphuric Acid	Hydrochloric Acid	Nitric Acid	Acetic Acid
Units	Short Tons 50 deg.	Short Tons 100%	Short Tons 100%	Short Tons 100%
Heavy Chemicals	775,000	32,000	[illegible]	[illegible]
Dyes and Organic Chemicals	227,000	36,000	[illegible]	[illegible]
Plastics and Resins	10,000	500	....	[illegible]
Wood Chem. and Naval Stores	8,000	700	....	....
Glass and Ceramics	600	2,400	....	....
Manufactured Gas and Coke	860,000	....	....	....
Explosives	230,000	....	[illegible]	....
Fertilizers and Insecticides	2,510,000	....	[illegible]	....
Leather, Glue and Gelatine	21,000	24,000	....	[illegible]
Lime and Cement	....	....	....	....
Oils, Fats and Greases	18,000	1,600	....	....
Paints and Pigments	525,000	....	[illegible]	[illegible]
Pulp and Paper	2,000	....	....	....
Petroleum Refining	1,210,000	....	....	....
Rayon and Cellulose Film	380,000	....	....	[illegible]
Rubber Goods	29 000	....	....	....
Soap and Glycerine	8,000	4,000	....	....
Sugar and Food Products	4,400	1,800	....	[illegible]
Textile Processing	112,000	12,000	[illegible]	[illegible]
Total for Process Industries	6,930,000	115,000	[illegible]	[illegible]
Total for Other Industries	1,787,000	3,000	[illegible]	[illegible]
Total Distribution	8,717,000	118,000	[illegible]	[illegible]

TRADE

coal-tar origin presents the most amazing parallel with average production for the 1925-1930 period reported at 379,972,000 lb. in contrast with the supply of 2,529,650,000 lb. made available in 1937.

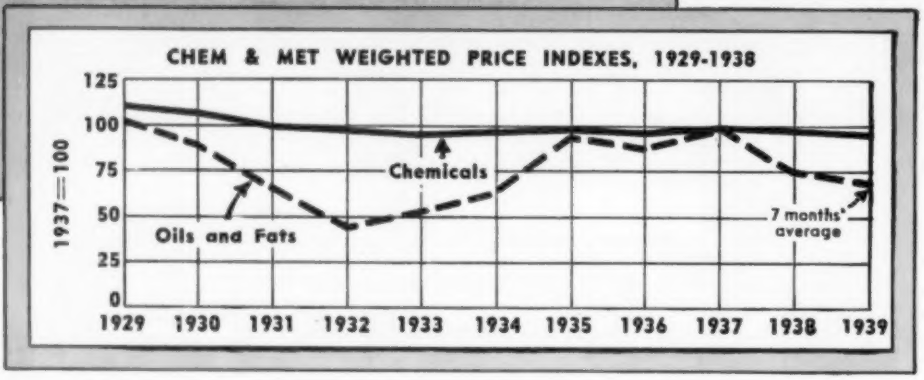
With all the evidence that production and distribution of chemicals are influenced greatly by developments within the industry itself, it also is apparent that the state of general business, or more precisely, the status of the large chemical-consuming branches, will dictate the trend. Sulphuric acid, for instance, finds its widest outlet in acidulating phosphate rock for use in the manufacture of fertilizers. Large tonnage of acid likewise is shipped to iron and steel mills which is further increased by heavy demand from other metallurgical works. In 1938, acid phosphate production was below the level of that for the preceding year and steel mills were in a comparative slump. With variations in the degree affected, other consumers of acid cut down their requirements and this condition resulted in a scaling down of activities at acid plants.

The rapid rise in the number and quantities of synthetic organic chemicals made available in the last few years is an outstanding example of growth within the industry. To a certain extent these synthetics have come into direct competition with some of the other chemicals and, as



OF CHEMICAL MATERIALS IN THE PROCESS INDUSTRIES—BASIS 1937

Oxalic Acid	Alcohol, (denatured)	Aluminum Sulphate	Caustic Soda	Soda Ash	Sodium Sulphates	Sodium Silicates	Sodium Phosphates	Sodium Nitrate	Ammonia	Chlorine	Salt	Sulphur	Lime	Gypsum	Litharge	White Lead	Zinc Oxide
Short Tons	Wine Gal. Fiscal Year 1937	Short Tons	Short Tons 76%	Short Tons 58%	Short Tons	Short Tons 40 deg.	Short Tons	Short Tons	Short Tons	Short Tons	Short Tons	Long Tons	Short Tons	Short Tons for Mfg.	Short Tons	Short Tons	Short Tons
250	....	17,000	110,000	1,100,000	15,000	2,000	9,800	23,000	100,000	80,000	5,450,000	777,000	250,000	2,000	2,000	....	1,000
300	42,000,000	600	128,000	242,000	15,000	1,000	2,000	....	5,000	147,000	238,000	49,000	20,000	....	....	....	700
....	6,200,000	....	1,500	600	....	....	....	....	100	....	....	....	30,000	....	....	....	....
....	....	....	....	600	....	....	....	....	....	....	....	....	4,500	....	....	....	....
....	....	300	600	860,000	62,000	....	....	600	....	....	3,500	....	199,000	80,000	7,600	2,500	5,200
....	....	....	5,000	1,200	....	....	....	....	....	....	....	....	26,000	....	....	....	....
....	5,600,000	....	4,000	3,700	....	1,500	....	76,000	30,000	....	....	68,000	8,000	....	....	....	....
....	....	....	....	....	....	1,000	....	204,000	175,000	....	5,700	415,000	48,000	....	18,200	....	....
250	60,000	600	1,700	3,000	2,000	1,000	9 400	....	100	....	400,000	....	76,000	....	....	....	....
....	....	....	....	....	....	5,000	....	....	....	....	....	....	....	770,000	....	....	....
....	....	250	15,500	2,500	....	....	....	....	....	....	5,800	....	18,000	....	....	....	....
....	8,500,000	850	1,100	1,800	....	2,500	900	....	....	....	....	64,000	18,000	10,000	10,500	101,800	67,600
....	....	135,000	68,000	108,000	350,000	298,000	....	....	....	157,000	....	302,000	450,000	1,000	....	....	....
....	1,850,000	....	97,000	12,000	....	....	....	....	4,000	....	....	9,000	12,500	2,000	8,300	....	....
....	....	....	186,000	2,600	8,000	....	....	....	500	....	....	....	....	....	....	....	....
....	....	....	16,000	2,600	....	....	....	....	200	....	....	37,000	3,500	....	1,700	200	67,200
....	210,000	....	95,000	186,000	3,000	160,000	39,500	....	300	....	46,000	....	7,000	....	....	....	....
....	2,300,000	600	600	1,400	....	2,000	9,800	5,000	5,800	....	1,380,000	6,000	35,000	....	....	....	....
1,000	....	5,800	44,000	38,000	120,000	8,000	35,600	....	6,000	25,000	46,000	....	5,000	....	....	....	9,000
1,800	66,720,000	161,000	774,000	2,566,000	575,000	482,000	107,000	308,500	327,000	409,000	7,575,000	1,727,000	1,210,500	865,000	48,300	104,500	150,700
3,400	42,414,000	201,000	66,000	407,000	39,000	225,000	21,000	371,500	11,000	53,000	1,642,500	73,000	2,294,500	45,000	35,600	2 300	1,300
5,200	109,134,000	362,000	840,000	2,973,000	614,000	707,000	128,000	680,000	338,000	462 000	9,217,500	1,800,000	3,505,000	910,000	83,900	106,800	155,000



ESTIMATED DISTRIBUTION OF CONSUMPTION OR SALES OF IMPORTANT CHEMICALS, 1929-1938

Chem. & Met. Estimates

Sulphuric Acid Consumption (50 Deg. Bé., 1,000 Short Tons)

Industry	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Fertilizer	2,418	2,477	1,455	780	1,200	1,650	1,720	1,987	2,510	2,100
Oil refining	1,570	1,420	1,348	1,240	1,140	1,100	980	1,100	1,210	1,120
Chemicals	890	820	700	674	725	910	940	985	1,020	790
Coal products	935	800	570	375	468	500	625	770	860	585
Iron and steel	800	660	480	270	390	475	630	770	850	500
Other metallurgy	675	560	410	310	300	400	520	560	620	350
Paints and pigments	225	200	180	160	170	330	400	450	525	430
Explosives	195	177	175	120	140	180	175	222	230	185
Rayon and film	150	145	175	176	242	256	303	330	380	310
Textiles	90	78	81	75	90	75	90	108	112	90
Miscellaneous	390	330	270	230	223	290	342	380	400	300
Total	8,338	7,667	5,904	4,410	5,148	6,166	6,725	7,632	8,717	6,760

Soda Ash Sales (58 Per Cent Ash, 1,000 Short Tons)

Industry	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Glass	672	561	502	362	507	500	662	780	800	630
Soap	213	200	166	173	170	160	170	184	186	185
Chemicals	335	350	424	415	510	605	590	640	700	595
Cleansers and modified sodas	125	112	94	88	94	100	120	130	140	110
Pulp and paper	110	100	78	66	80	70	80	90	108	80
Water softeners	60	55	50	45	47	40	35	38	38	33
Oil refining	18	16	9	8	8	8	11	12	12	12
Textiles	40	30	31	27	34	28	48	44	38	30
Exports	40	36	28	13	25	33	43	44	55	50
Miscellaneous	47	40	120	115	179	119	112	121	150	113
Total	1,660	1,500	1,502	1,312	1,654	1,663	1,871	2,082	2,287	1,837

Caustic Soda Sales (76 Per Cent Caustic, 1,000 Short Tons)

Industry	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Soap	108	100	91	85	86	93	96	90	92	92
Chemicals	135	100	117	96	100	107	118	135	158	134
Oil refining	134	117	104	93	87	84	81	88	97	96
Rayon and film	111	110	108	109	144	147	163	170	186	155
Lye	25	22	22	30	31	36	38	45	48	40
Textiles	42	30	32	30	38	33	34	43	44	36
Rubber reclaiming	40	20	14	8	9	10	11	14	16	11
Vegetable oils	11	10	9	9	9	10	14	15	16	17
Pulp and paper	45	42	36	34	40	33	38	43	48	35
Exports	60	63	66	55	60	65	69	77	102	102
Miscellaneous	48	38	35	38	41	48	57	74	76	68
Total	750	652	634	587	645	666	719	793	882	784

Sulphur Consumption (1,000 Long Tons)

Industry	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Chemicals	508	494	355	321	491	512	555	620	777	484
Fertilizers and insecticides	415	418	254	155	242	247	230	266	415	220
Pulp and paper	265	235	178	153	197	176	204	260	302	174
Explosives	67	48	30	27	37	43	42	53	68	50
Dyes and coal tar products	47	41	30	34	40	34	39	46	49	40
Rubber	43	31	23	18	24	30	33	39	37	29
Paint and varnish	5	4.5	4	4	4	4	48	54	64	50
Food products	5	4.5	4.7	4	4	4	4	4.5	6	5.5
Miscellaneous	136.7	110.6	72	40	75	60	68.5	78	82	47.5
Total	1,581.7	1,396.6	968.7	756	1,114	1,110	1,232.5	1,420.5	1,800	1,100

Chlorine Consumption (1,000 Short Tons)

Industry	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Chemicals	60	58	50	49	74	122	166	190	220	209
Pulp and paper*	96	93	95	90	101	103	109	120	157	150
Sanitation	31	29	30	30	32	33	35	38	46	44
Textiles	24	18	18	17	21	18	19	21	25	24
Miscellaneous	8	7	7	7	9	9	10	11	14	13
Total	219	205	200	193	237	285	339	380	462	440

* Includes estimated chlorine made and consumed in pulp mills, not reported by Census.

in the case of methanol, have had a dislocating effect upon divisions which previously had acquired positions of seeming security. In the main, however, these new products either have developed distinctive outlets or have broadened existing channels of distribution. Incidentally, sales of synthetic methanol in recent years have far outstripped those which may be regarded as normal for the wood distillation product in the pre-synthetic era.

While crude coal-tar and grains have figured prominently as raw materials upon which the synthetic chemical industry has drawn heavily, petroleum has become increasingly important and the number of petroleum chemicals has been gaining both in variety of products and in volume of sales.

It may be stretching a point to classify rayon as a new industry yet its prominence has been attained within the last decade. The role it has played in influencing the output of chemicals may be inferred by reference to a few statistics. In 1929 estimates of chemicals used in the manufacture of rayon and film included 150,000 tons of sulphuric acid and 111,000 tons of caustic soda. In 1937 similar estimates were 380,000 tons of acid and 186,000 tons of caustic or a net combined gain of 304,000 tons for the 1937 period. During the same interval, production of carbon bisulphide increased by approximately 65,000,000 lb. and a large part of this increase can be attributed to the demands of rayon manufacturers.

With the exception of moderate recoveries from the low levels reached in 1932 and 1933, the course of chemical prices over a long period has been downward. This price movement is a tribute to the improvement in processes and equipment, to the greater efficiency in management, and to the concerted efforts which manufacturers have made to reduce costs of production. It is difficult to measure the extent to which the declining price trend has contributed to the rising trend of production but it is certain that price considerations have been a factor in enlarging distribution fields for many selections.

Chemical Consumption Index

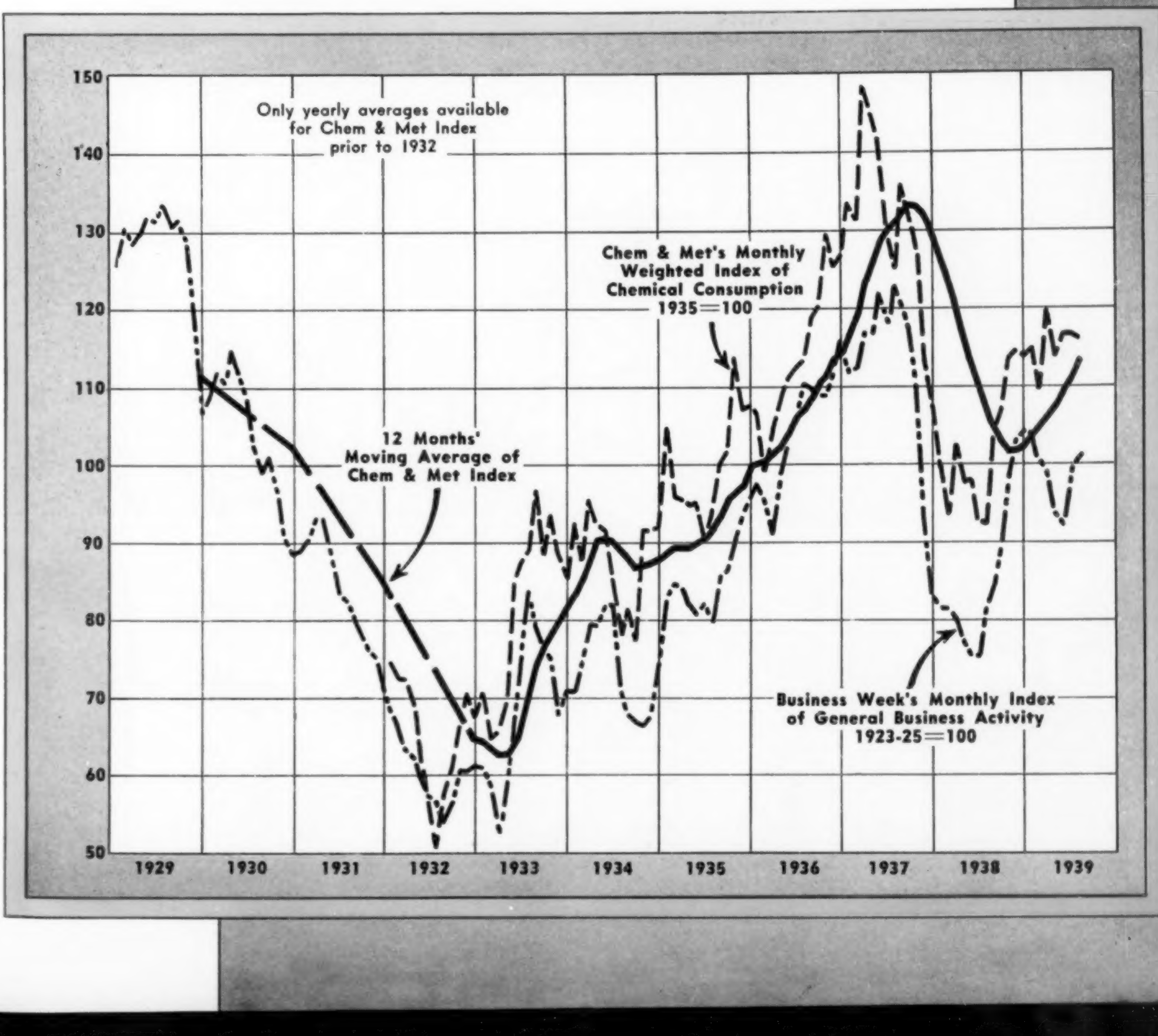
Just a year ago *Chem. & Met.* introduced for the first time a new weighted index of chemical consumption which is revised monthly so as to give a continuous record, accurately

reflecting the state of health of the chemical industry. In normal years when inventories remain substantially constant from one year to the next, the new index also serves as an indicator of chemical production. Since its introduction the index has been calculated back to 1929, although detailed by months only since 1932. A plot of the index, by months from 1932 to date, appears below. On the same chart for comparison is *Business Week's* monthly index of general business activity.

A third plot, that of the 12 months' moving average of the *Chem. & Met.* consumption index, is included since it averages out the minor fluctuations and accurately shows the trend. This type of plot, although well known to statisticians, is not so much used by others as it deserves to be. Each point on the moving average plot is the average of the 12 months ending at that time. Thus, the point for December of any year is the average for the entire year. As can be demonstrated by an examination of the curve, the moving average plot can be projected with much greater safety for purposes of prediction than can the consumption index plot. Henceforth, therefore, a plot of the moving average will be included as an added feature of the monthly publication of the chemical consumption index.

The basis of the new index was devised after a long period of examination of the currently published indicators. Data are not available at frequent intervals to show the actual consumption of chemicals. On the other hand, monthly statistics of the production of certain large chemical consuming industries are provided by government bureaus, trade associations and other sources. It was found possible to relate the production of 13 of these industries to their consumption of chemicals. As a base year, 1935 was selected since it was possible in that year to check many of the consumption figures against actual Census figures. The resulting allocation of consumption to the several indicator industries is as follows: Fertilizer, 19.47; pulp and paper, 12.39; glass (six kinds), 10.58; petroleum refining, 10.51; paint, varnish and lacquer, 10.35; iron and steel, 7.20; rayon, 6.29; textiles, 6.11; coal products, 5.74; leather, glue and gelatine, 3.95; explosives, 3.62; rubber, 2.17; plastics, 1.62; and the total, 100 per cent. Each month, then, the index percentage for each industry of the list is raised or lowered in accord with its current production statistics.

It may be argued that the new index takes no account of the consumption of chemicals in the chemical industry itself. This consumption, however, is included inferentially since the chemical industry's products are largely the raw materials of such industries as those considered in the index. Barring large changes in inventory, therefore, the index is also an accurate reflection of the chemical industry's use of its own intermediate products.



FOREIGN TRADE

TOTAL export trade of this country in 1938 declined 8 per cent in value from the figure for the preceding year. On this basis, exports of chemicals and related products made a favorable showing as the drop in value was 7.6 per cent. General imports in 1938 recorded a drop in value of 35.2 per cent while the falling off in chemical imports was but 23.9 per cent.

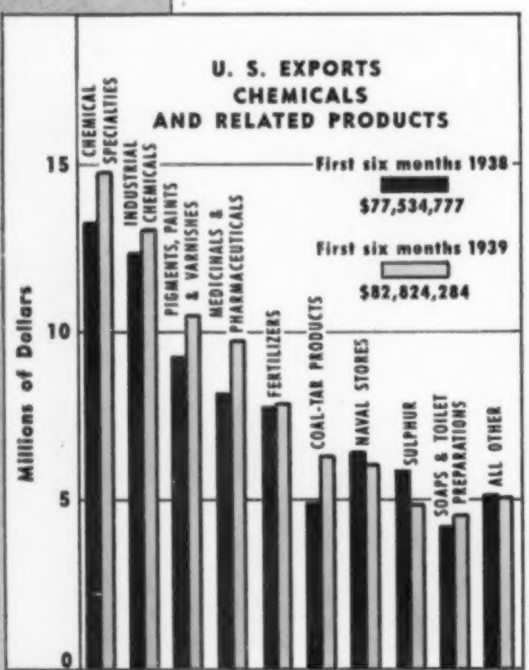
The current year has brought a reversal in foreign trade as far as chemicals and related products are concerned. According to data compiled by the Department of Commerce and covering the first half of the year, exports have advanced steadily and although some commodities have been shipped out in smaller volume, the trend in general has been upward with some groups bettering the comparable 1937 totals by as much as 26 per cent. Total shipments for the chemical and related products classification for the first half of the year reached a value of $82,825,000 compared with $77,500,000 for the 1937 period, or an overall increase of 7 per cent.

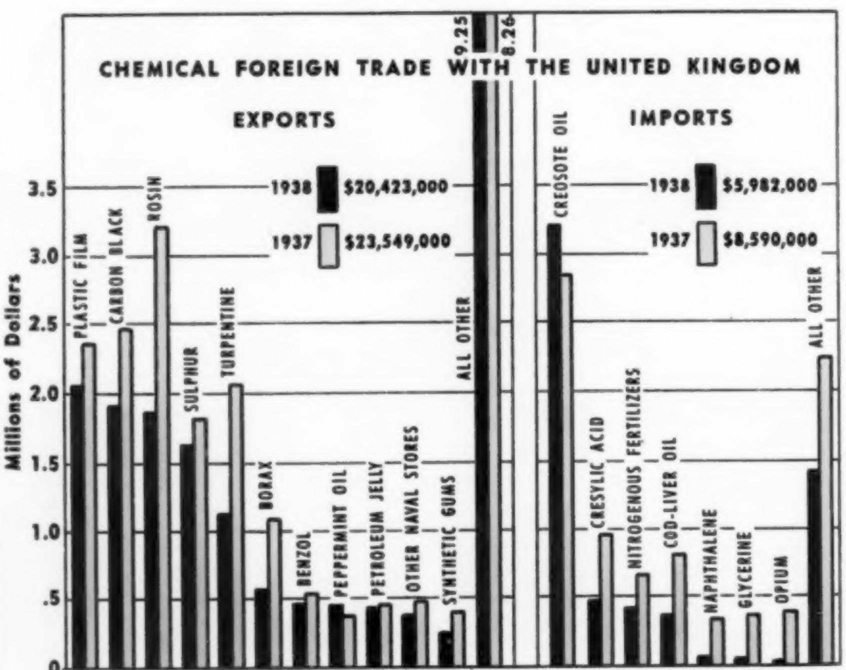
Coal-tar products, medicinal preparations, chemical specialties, and paints, varnishes, and lacquers recorded the most outstanding gains with smaller increases being noted in foreign shipments of vegetable tanning extracts, industrial chemicals, essential oils, fertilizers, soaps, and toilet preparations.

Exports of coal-tar products were valued at $6,318,000 in the first half of this year compared with $4,979,000 in the first half of 1938. In this classification shipments of coal-tar colors, dyes, and stains increased from 4,753,000 lb. to 5,082,000 lb., and benzol from 4,594,000 gal. to 9,759,000 gal.

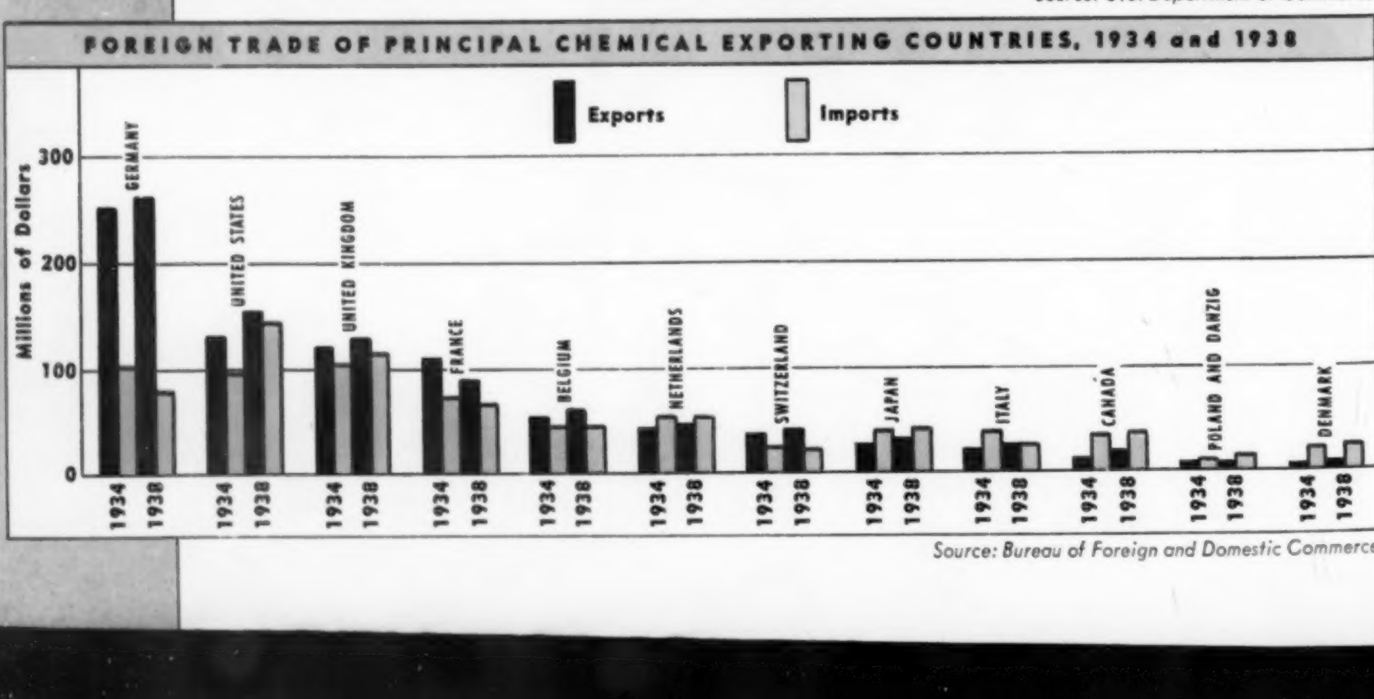
Medicinal and pharmaceutical exports increased in value from $8,250,000 in the first half of 1938 to $9,808,000 in the current year period, a gain of 19 per cent, with practically every country and trading area of the world sharing in the business. In this group exports of biologics increased in value from $1,329,500 to $1,786,000 during these periods; non-proprietaries, from $2,633,500 to $3,065,000; and proprietaries, from $3,970,000 to $4,393,000.

Chemical specialty exports gained approximately 13 per cent in value to





Source: U.S. Department of Commerce



Source: Bureau of Foreign and Domestic Commerce

U. S. CHEMICAL EXPORTS OF MAJOR CLASSES BY COUNTRIES OF DESTINATION

Value in thousands of dollars: data from Chemical Division, Bureau of Foreign and Domestic Commerce.

	Total, all Chemicals		Coal-Tar Products		Medicinal and Pharmaceutical Preparations		Chemical Specialties and Industrial Chemicals		Pigments, Paints, Lacquers and Varnishes		Fertilizers and Materials		Naval Stores		Sulphur	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Europe	64,339	54,141	6,135	3,933	2,789	2,709	18,631	18,515	8,408	7,869	7,136	8,332	11,838	6,447	5,516	4,988
Austria	218	......	10	......	11	......	82	......	14	......	66	......	2	......	......	......
Belgium	5,309	4,544	2,049	1,449	97	61	1,038	986	674	531	740	1,044	536	279	22	115
Czechoslovakia	870	672	177	44	4	7	94	69	93	88	233	156	228	286	10	8
Denmark	682	709	1	6	13	10	123	144	116	99	250	326	156	103	14	72
Finland	724	628	43	50	19	43	156	189	93	89	55	34	263	132	55	71
France	7,749	7,033	1,422	629	76	80	1,977	1,947	1,431	1,288	384	960	34	40	1,947	1,834
Germany	8,088	7,176	266	146	163	84	2,034	2,099	1,198	1,104	1,468	2,555	1,718	570	896	617
Italy	1,673	1,270	55	43	29	49	431	227	338	470	462	324	291	139	8	3
Netherlands	5,825	4,425	714	206	123	131	1,378	1,139	358	339	1,246	1,172	1,277	712	394	432
Spain	868	628	31	3	44	2	338	215	22	62	733	342	1	......	......	......
Sweden	3,265	3,011	97	105	74	120	962	869	422	512	694	771	779	416	94	115
United Kingdom	25,145	20,199	1,014	874	1,840	1,842	9,262	5,660	3,004	2,546	211	155	5,916	3,510	1,894	1,681
North America and West Indies	51,370	42,815	3,291	2,750	5,949	5,469	20,161	19,645	5,155	4,068	3,532	3,848	2,786	1,777	4,268	1,978
Canada	30,544	25,258	2,708	2,270	1,607	1,540	12,777	12,914	2,566	1,956	2,774	2,984	2,130	1,379	3,658	1,588
Honduras	1,213	1,228	2	5	144	141	790	766	46	77	18	69	4	2	5	4
Panama	1,622	1,466	22	23	374	384	319	264	255	267	5	6	2	30	2	1
Mexico	7,239	5,356	379	290	1,151	850	3,232	2,724	776	498	193	252	106	91	228	157
Cuba	5,274	4,095	179	112	1,554	1,415	1,566	1,356	604	378	356	330	392	199	5	4
Netherlands West Indies	953	1,090	7	1	69	92	347	410	193	260	4	1	4	4	171	142
British West Indies	1,515	1,534	8	9	361	380	280	319	281	258	138	114	31	22	38	20
South America	18,651	17,394	748	755	3,628	3,660	5,251	5,446	2,874	2,817	100	153	3,027	1,812	196	398
Argentina	5,342	4,889	275	228	796	810	1,645	1,731	966	1,034	18	25	1,142	607	154	292
Brazil	3,516	3,112	252	269	374	421	1,061	1,106	514	420	7	5	1,067	676	9	90
Colombia	3,020	2,769	69	50	939	837	820	765	471	474	11	21	240	171	11	12
Venezuela	2,374	2,594	20	20	881	1,018	449	507	432	468	30	39	74	51	2	1
Asia and Oceania	41,497	32,096	4,666	2,431	4,932	4,630	9,453	9,041	3,797	2,910	5,304	2,899	4,168	2,079	2,180	2,984
India	4,072	4,026	309	247	1,634	1,538	551	643	354	285	53	58	172	175	13	59
China and Hong Kong	6,252	3,196	2,167	813	724	717	1,064	936	268	154	21	10	197	110	167	10
Japan	11,265	6,279	1,730	1,111	184	97	3,073	2,024	943	544	3,371	1,946	1,659	551	......	......
Philippine Islands	7,311	6,164	43	37	1,437	1,313	1,000	943	874	801	1,101	636	187	47	4	1
Australia	5,521	5,578	49	36	341	343	1,820	1,899	697	503	......	29	972	627	1,292	1,985
New Zealand	1,431	1,549	7	12	59	68	306	391	133	117	......	......	147	83	625	771
Africa	6,027	5,583	46	22	682	612	1,538	1,494	1,321	991	883	1,224	322	213	504	501
Union of South Africa	3,955	2,819	38	15	374	347	990	855	1,173	832	324	83	187	111	319	228
Other British Africa	463	332	......	......	160	93	109	99	24	32	22	21	67	20	......	......
Egypt	878	1,452	6	2	111	145	141	189	37	43	511	1,003	9	9	......	3
Portuguese Africa	343	299	2	4	7	9	187	230	42	59	2	1	50	64	11	6
Total	181,884	152,029[2]	14,886	9,891	17,980	17,080	55,034	54,141	21,555	18,655	16,955	16,456	22,141	12,328	12,664	10,849

[1] Preliminary, incomplete figures. [2] Exclusive of a few miscellaneous classes such as crude drugs and botanicals, essential oils, glue, printing ink, matches, etc., exceeding a total of $6,000,000.

U. S. CHEMICAL IMPORTS OF MAJOR CLASSES BY COUNTRIES OF ORIGIN

Value in thousands of dollars: data from Chemical Division, Bureau of Foreign and Domestic Commerce.

	Total, all Chemicals		Coal-Tar Products		Medicinal and Pharmaceutical Preparations		Industrial Chemicals		Pigments, Paints and Varnishes		Fertilizers and Materials		Gums, Resins and Balsams		Drugs, Herbs and Botanicals	
	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937
Europe	66,363	79,044	13,986	16,538	3,897	3,566	13,852	16,394	1,804	2,135	15,557	23,622	1,332	1,535	2,976	2,671
Belgium	4,535	5,002	868	1,139	201	292	2,120	1,551	88	88	845	1,581	244	250	94	70
Czechoslovakia	254	433	126	134	6	2	108	252	1	4	7	24	2	1	3	8
France	6,317	7,849	195	250	375	298	925	2,710	186	164	239	694	113	155	148	142
Germany	21,217	28,378	5,093	5,978	1,289	1,055	6,358	7,248	422	491	6,783	12,286	385	439	137	114
Italy	1,950	2,697	......	7	82	88	945	758	113	156	8	409	96	218	155	315
Netherlands	8,892	9,219	628	1,609	1,139	1,092	1,050	1,345	453	510	4,495	4,219	5	4	880	188
Norway	4,412	5,662	......	......	......	......	48	83	111	2	2,027	2,995	2	1	72	70
Spain	1,764	1,580	......	......	6	......	83	21	1	117	262	......	15	38	143	137
Switzerland	3,980	3,695	3,191	2,867	348	327	294	135	6	10	3	27	......	......	12	13
United Kingdom	8,811	9,491	3,738	4,322	322	311	1,044	1,165	380	478	617	733	405	179	679	639
North America and West Indies	13,986	16,662	666	945	50	66	4,536	5,659	137	16	5,706	6,709	314	266	564	668
Canada	11,328	13,218	655	902	43	62	3,860	4,689	136	7	5,530	6,554	13	8	369	397
Mexico	979	1,517	11	39	4	4	436	587	......	3	127	122	......	163	22	38
South America	19,612	26,163	......	......	28	26	764	2,514	......	......	11,117	14,267	61	138	393	469
Argentina	2,600	3,709	......	......	......	......	166	509	......	......	508	949	......	......	70	75
Brazil	5,202	6,552	......	......	28	26	5	37	......	......	37	113	18	63	218	239
Chile	11,098	14,966	......	......	......	......	591	1,933	......	......	10,436	12,979	......	......	17	31
Asia and Oceania	32,588	42,502	545	843	920	1,244	1,771	1,562	19	15	987	2,106	5,529	8,232	2,734	5,276
British India	4,012	5,567	1	......	......	......	......	......	8	8	60	187	3,342	4,576	465	600
China and Hong Kong	18,494	21,350	......	......	144	166	229	98	......	......	21	24	......	......	182	314
Netherlands Indies	1,323	2,404	......	......	......	......	......	......	......	......	1	......	957	1,367	98	744
Japan	6,028	8,509	540	708	775	1,072	1,466	1,295	10	6	883	1,706	......	......	987	2,217
Africa	1,426	2,260	15	23	......	......	41	284	10	8	27	......	630	842	238	300
Egypt	752	962	......	......	......	......	6	5	8	4	......	......	603	756	46	90
Algeria, Tunis and Other French Africa	343	728	......	......	......	......	34	276	......	......	......	......	3	31	......	3
Total	133,975	166,691*	15,212	18,349	4,895	4,902	20,964	26,455*	1,970	2,174	33,394	46,704	7,866	11,013	6,905	9,384

* Includes "Special Imports" countries not shown.

a total of $14,850,000 during the current year period due mainly to heavier shipments of plastic materials, exports of which increased from 5,176,000 lb. in the first half of 1938, to 9,942,000 lb. this year.

Exports of paint materials, including pigments, advanced 14 per cent in value during the current year period to $10,551,600, compared with the first half of 1938. In this classification shipments of chemical pigments increased from 94 to 122 million pounds; lacquers, from 783,000 to 809,000 gal.; ready-mixed paints, from 1,182,000 to 1,218,500 gal.; and kalsomines, from 3,425,000 to 4,760,000 lb.

Other items on the chemical and related products export list recording

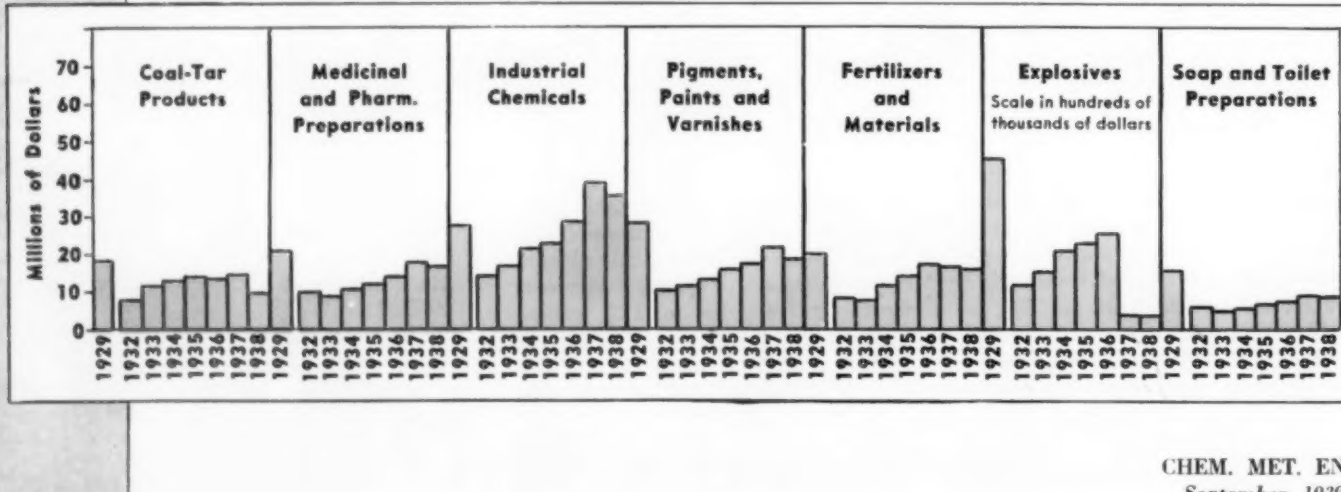
(*Please turn to page 604*)

UNITED STATES EXPORTS OF CHEMICALS

Source: Chemical Division of U. S. Bureau

	Quantity in Thousands (Pounds Except as Otherwise Specified)						Value in Thousands of Dollars					
	1926–1930	1929	1935	1936	1937	1938	1926–1930	1929	1935	1936	1937	1938
GRAND TOTAL VALUE	....	....	....	....	....	....	$187,825	$209,988	$162,348	$154,419	$181,938	$159,534
Chemical and allied products (Group 8)	....	....	....	....	....	....	134,914	152,109	130,092	116,902	139,447	128,910
Coal-tar chemicals												
Benzol (gals.)	28,843	33,346	14,666	19,178	20,481	10,613	7,049	8,537	2,513	2,918	2,824	1,802
Coal-tar pitch (tons)	....	10	82	85	23	29	....	204	895	716	284	222
Colors, dyes, stains	30,074	34,130	19,631	17,408	16,689	8,576	6,300	7,279	6,873	6,081	6,244	3,825
Other products, except medicinals	....	....	....	....	....	....	2,631	2,041	3,317	4,061	5,525	4,041
Medicinal and pharmaceutical preparations	....	....	....	....	....	....	20,081	21,467	12,199	14,393	17,979	17,079
Biologics (antitoxins, serums, vaccines, etc.)	....	....	....	....	....	....	2,036	2,530	1,794	2,200	2,564	2,855
Industrial chemical specialities												
Insecticides, disinfectants, etc	20,093	28,194	23,001	23,176	21,687	23,957	4,236	5,344	2,428	2,868	3,134	3,279
Petroleum jelly	6,976	7,073	14,817	22,177	39,361	37,565	901	926	799	1,085	1,731	1,606
Water softeners, purifiers, etc	3,092 [1]	3,264	2,351	2,710	3,220	2,711	365 [1]	394	274	319	378	325
Metal working compounds	1,809	2,240	1,846	2,082	3,003	1,839	275 [1]	336	182	215	332	221
Other	....	....	....	....	....	....	7,229	7,457	9,184	11,485	18,116	19,482
Industrial chemicals												
Acids and anhydrides	....	27,417	28,344	31,998	42,087	30,722	1,133	1,264	1,117	1,446	1,716	1,403
Alcohols												
Methanol (gals.)	540	498	619	668	839	196	367	403	300	283	314	80
Glycerine	1,099	1,374	3,354	1,146	1,375	3,746	179	198	450	183	338	427
Other	2,811	3,500	4,779	11,697	15,487	20,804	367	488	458	1,275	1,722	1,897
Acetone	5,500 [1]	7,897	2,884	5,636	9,654	11,212	492 [1]	708	296	456	626	635
Formaldehyde	2,670	2,588	2,498	1,844	2,865	1,765	221	225	134	89	119	77
Nitro or aceto cellulose solutions, etc	1,815 [1]	2,111	3,408	3,991	4,309	4,158	509 [1]	625	671	779	830	789
Aluminum sulphate	47,086	53,176	66,182	57,576	63,615	55,430	549	608	685	578	679	578
Calcium carbide	4,297	4,345	4,496	4,164	4,831	3,982	184	185	164	148	157	124
Calcium chloride	36,775 [1]	30,851	61,471	55,662	43,463	48,236	439 [1]	363	525	504	415	397
Sodium compounds	500,694	705,196	522,861	512,141	703,196	519,986	10,548	12,389	9,476	9,321	12,011	10,417
Borate (borax)	112,770	159,768	228,895	204,042	307,544	155,038	2,625	2,935	3,242	3,120	4,709	2,642
Carbonate (soda ash, sal soda)	68,348	90,404	89,336	90,047	121,549	102,033	1,269	1,535	1,139	1,095	1,274	1,327
Hydroxide (caustic soda)	114,211	122,045	139,137	153,912	204,565	200,047	3,363	3,566	2,999	3,082	3,641	4,095
Gases, compressed and liquefied	11,563 [1]	12,735	36,298	37,897	23,749	15,859	989 [1]	1,058	1,176	1,360	1,529	1,282
Other industrial chemicals	....	....	....	....	....	....	8,525	9,683	8,176	5,907	10,058	10,055
Pigments, paints and varnishes	....	....	....	....	....	....	23,397	29,111	16,344	17,788	21,544	18,655
Mineral earth pigments, etc	39,014	41,960	47,431	55,653	38,648	43,172	923	863	473	569	631	590
Carbon black, bone black and lamp black	72,961	95,030	143,570	156,197	185,731	167,103	6,019	8,455	6,779	7,350	8,813	7,663
Other chemical pigments	57,854	69,339	22,766	23,662	28,182	23,132	4,130	5,277	2,006	2,253	2,712	2,190
Nitrocellulose lacquers (gal.)	(2)	558	1,172	1,500	1,917	1,503	(2)	1,695	1,730	2,167	2,802	2,360
Other paints, stains, enamels	....	....	....	....	....	....	9,740	11,454	4,836	4,858	5,932	5,299
Varnishes (gal.)	1,265 [2]	873	393	448	486	386	2,585 [2]	1,367	520	592	654	554
Fertilizers and materials (tons long)	1,336	1,534	1,484	1,649	1,521	1,569	17,917	20,441	14,809	17,751	16,954	16,531
Ammonium sulphate (tons)	128	145	78	106	74	31	6,046	6,296	2,040	2,682	2,014	763
Other nitrogenous (tons)	15	24	149	139	141	178	754	1,230	3,332	3,243	3,389	4,402
Phosphate rock (tons)	987	1,143	1,104	1,209	1,053	1,141	4,927	5,387	5,774	6,743	5,518	6,638
Superphosphate (tons)	91	85	55	68	79	90	1,429	1,489	534	688	841	945
Other (tons)	215	137	98	127	175	129	4,761	6,039	3,129	4,395	4,892	3,784
Explosives and fuses	....	....	....	....	....	....	4,072	4,549	2,439	2,618	3,862	3,666
Dynamite	13,840	16,277	9,846	12,253	14,431	15,614	1,964	2,228	1,261	1,568	1,982	2,186
All other	....	....	....	....	....	....	2,108	2,321	1,178	1,050	1,881	1,480
Soap and toilet preparations	....	....	....	....	....	....	15,998	16,061	7,208	8,075	9,198	8,963
Soap, washing powders, etc	....	74,540	27,123	30,558	32,692	26,514	8,118	7,277	2,584	2,729	3,201	2,797
Dentifrices	3,731	3,777	2,177	2,331	2,429	2,573	3,100	2,901	1,623	1,707	1,830	2,022
Talcum and other toilet powders	....	....	....	....	....	....	1,594	1,531	711	804	966	978
Creams, rouges, etc	....	....	....	....	....	....	2,078	2,048	1,142	1,516	1,734	1,112
Other toilet preparations	....	....	....	....	....	....	1,821	2,302	1,148	1,319	1,470	1,553
Related products from other groups	....	....	....	....	....	....	52,911	57,879	32,256	37,517	42,491	30,624
Naval stores, gums and resins (bbls.)												
Rosin	1,270	1,437	1,195	1,196	1,029	847	20,008	20,442	9,994	11,236	14,612	7,395
Spirits of turpentine (gal.)	14,271	16,304	10,380	12,342	11,550	8,771	8,392	8,530	4,895	5,175	4,233	2,292
Other gums	....	....	....	....	....	....	1,866	2,025	1,600	2,513	3,285	2,641
Crude drugs and botanicals	5,074	4,683	4,775	4,712	5,259	4,291	3,341	3,690	1,195	1,871	1,506	1,781
Essential oils	....	6,043	11,100	2,112	2,234	1,614	2,223	2,436	2,679	2,339	2,647	2,368
Linseed oil	2,171	2,208	986	973	987	890	257	288	101	96	114	94
Sulphur (tons)	422	873	413	567	645	577	14,850	18,278	8,001	10,894	12,089	10,802
Pyroxylin products, sheets, rods, tubes, scrap, film support	3,255	3,945	5,808	5,276	7,725	4,798	1,974	2,190	3,791	3,393	4,005	3,251

[1] Average 1928–30. [2] Lacquers included with varnishes.

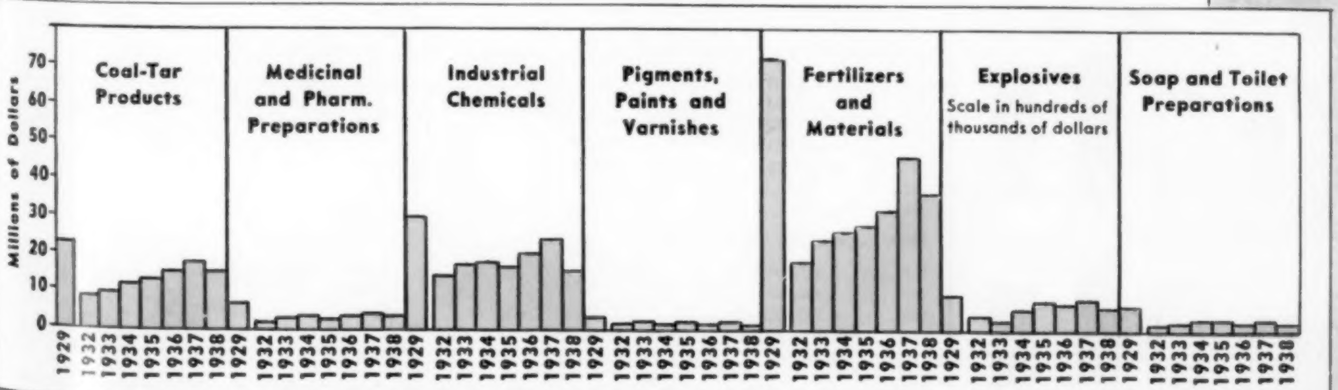


UNITED STATES IMPORTS OF CHEMICALS

of Foreign and Domestic Commerce

	Quantity in Thousands (Pounds Except as Otherwise Specified)						Value in Thousands of Dollars					
	1926–1930	1929	1935	1936	1937	1938	1926–1930	1929	1935	1936	1937	1938
GRAND TOTAL, VALUE	....	....	....	....	....	....	$209,469	$230,186	$113,043	$127,526	$163,218	$121,279
Chemical and allied products (Group 8)	....	....	....	....	....	....	132,811	144,062	68,720	78,244	102,571	78,021
Coal-tar chemicals	....	....	....	....	....	....	21,370	22,823	13,558	15,212	18,353	15,970
Dead or creosote oil (gal.)	83,608	79,301	34,513	41,384	58,190	55,392	11,802	10,119	3,537	4,566	6,806	6,316
Other crudes	....	....	....	....	....	....	1,403	2,051	1,224	2,072	2,972	1,754
Intermediates	2,940	3,962	2,062	2,327	2,812	2,756	1,194	1,646	2,447	2,485	2,704	2,270
Colors, dyes, stains	5,863	7,593	4,606	3,769	3,381	3,317	6,942	8,448	6,034	5,698	5,201	5,062
Other finished products	193	279	162	177	264	157	480	559	315	391	669	568
Medicinal and pharmaceutical preparations	....	....	....	....	....	....	5,573	6,422	4,128	4,890	4,894	4,328
Industrial chemicals	....	....	....	....	....	....	26,541	30,698	17,393	20,929	24,784	16,021
Acetic acid	25,806[1]	29,235	35,096	28,278	31,633	6,356	1,808[1]	2,117	2,079	1,518	1,696	338
Arsenious (white arsenic)	22,124	26,314	30,150	35,172	38,543	28,476	781	956	737	741	820	608
Tartaric	2,293	2,220	15	300	327	....	611	689	3	50	52	....
Other acids and anhydrides	42,756	20,741	4,369	5,318	7,177	6,227	1,931	658	480	827	543	451
Ammonium compounds, n.e.s.	22,741	20,030	11,995	13,420	15,602	10,547	849	697	309	344	368	272
Cobalt oxide	394	476	557	814	843	373	737	885	503	886	1,059	519
Glycerine	21,122	20,345	8,290	14,596	20,977	15,665	2,669	1,365	665	1,793	4,071	1,247
Iodine	696	627	376	592	1,967	571	2,330	2,249	421	558	1,784	464
Potassium compounds												
Bitartrate, crude, argols, wine lees	19,890	18,001	16,368	16,806	23,820	31,781	1,872	2,113	903	911	1,699	2,477
Carbonate	16,502	22,644	4,125	2,795	1,576	583	759	1,024	232	151	81	31
Nitrate (tons)	10	13	40	59	....	....	459	546	1,244	1,701	....	....
Other	38,162	49,315	20,599	19,736	20,685	17,883	1,901	2,407	1,212	1,264	1,116	1,148
Sodium cyanide	33,686	40,047	26,540	27,179	35,292	26,387	2,668	3,199	2,930	2,901	3,762	2,404
Sodium sulphate (salt cake)	....	193,267	220,759	270,394	197	127	....	830	959	1,334	1,872	1,332
Other sodium compounds	....	....	....	....	....	....	2,099	3,167	730	1,193	1,257	850
Other industrial chemicals	....	....	....	....	....	....	5,067	7,796	3,986	4,757	4,605	3,880
Pigments, paints, and varnishes	....	....	....	....	....	....	3,556	3,822	2,109	1,971	2,179	1,368
Fertilizers and materials	2,152	2,318	1,334	1,461	2,046	1,554	67,997	72,340	27,317	31,693	46,704	36,496
Ammonium sulphate (tons)	24	19	79	153	83	121	1,003	763	1,760	3,269	1,917	3,088
Calcium cyanamide (tons)	132	184	100	113	123	119	4,862	6,221	2,359	2,622	3,041	2,996
Sodium nitrate (tons)	839	930	391	472	629	577	33,252	34,913	7,940	9,160	11,649	10,732
Other nitrogenous (tons)	204	193	181	244	320	244	9,088	8,509	4,436	5,877	9,282	7,029
Phosphates (tons)	101	105	44	49	114	49	2,178	2,149	753	931	2,085	907
Potash fertilizers (tons)												
Chloride, crude (tons)	220	231	234	211	373	119	7,654	8,225	4,744	5,194	9,725	5,372
Manure salts (tons)	350	391	85	35	40	8	4,496	5,113	1,054	475	592	113
Sulphate crude (tons)	78	88	62	65	104	65	3,455	3,648	2,530	2,090	3,316	2,193
Other (tons)	139	77	74	53	184	107	1,784	653	592	531	3,162	2,179
Other fertilizers (tons)	65	100	84	66	75	63	225	2,146	1,150	1,554	1,936	1,888
Explosives	....	....	....	....	....	....	1,022	960	827	738	864	655
Soap and toilet preparations	....	....	....	....	....	....	6,739	6,988	3,388	2,811	3,131	2,409
Soap	6,706	7,030	22,442	3,920	3,711	2,994	1,127	1,263	1,162	540	555	418
Perfume materials	....	....	....	....	....	....	3,228	3,296	1,478	1,580	1,882	1,453
Perfumery and toilet waters	....	....	....	....	....	....	1,659	1,504	562	515	501	378
Other toilet preparations	....	....	....	....	....	....	732	925	186	176	193	160
Other related products	....	....	....	....	....	....	76,658	86,124	44,323	49,282	60,647	43,258
Casein or lactarene	25,045	27,583	3,230	16,200	5,210	417	2,979	3,323	262	1,309	571	28
Naval stores, gums, resins												
Varnish gums and resins												
Damar	15,369	19,131	15,005	15,708	28,168	11,542	1,969	2,403	783	903	1,205	747
Lac, crude, seed, etc	8,333[1]	7,976	7,484	16,720	20,678	15,154	2,152[1]	2,579	853	1,482	1,735	992
Shellac	26,554	33,335	20,054	14,878	20,760	12,553	9,820	12,789	2,736	1,723	2,247	1,117
Other	45,341	42,846	21,956	21,354	26,928	17,261	5,484	3,701	1,217	1,134	1,591	797
Tar, pitch and turpentine	....	....	....	....	....	....	341	335	227	233	168	111
Camphor, natural, crude	2,667	4,204	1,542	2,286	1,912	784	1,123	1,580	422	625	554	237
Camphor, natural, refined	1,258	1,431	1,256	1,049	1,016	719	706	793	499	470	466	329
Camphor, synthetic	2,901	3,957	926	1,967	1,828	564	1,171	1,376	321	637	643	207
Chicle	12,833	13,223	7,775	6,750	10,660	7,872	6,460	6,621	1,887	1,605	3,009	2,457
Gum arabic	8,657	8,471	7,955	8,424	9,494	8,693	870	913	622	619	771	540
Other gums, resins, balsams	....	....	....	....	....	....	2,805	2,547	1,428	1,715	3,290	1,323
Crude drugs and botanicals	116,216	130,754	107,857	116,428	....	....	9,474	10,582	7,594	6,905	9,408	8,974
Pyrethrum flowers	10,017	9,013	15,578	11,757	20,092	14,537	1,905	2,061	2,042	943	2,204	2,486
Licorice root	75,450	88,267	59,731	55,161	69,567	66,163	2,006	2,260	1,134	1,037	1,353	1,266
Opium, crude	136	168	88	171	184	171	880	1,071	407	709	663	716
Other	30,613	33,307	32,460	49,339	....	....	4,683	5,190	4,011	4,216	5,188	4,506
Essential and distilled oils	....	....	....	....	....	....	6,588	7,576	4,414	4,738	5,457	4,495
Linseed oil	5,649	9,961	2,232	760	393	123	414	739	91	31	24	7
Tung oil	105,575	119,678	120,059	134,830	174,885	167,456	12,367	14,972	13,131	17,838	20,100	11,923
Pyroxylin, celluloid, pyralin, etc	....	....	....	....	....	....	2,461	2,713	242	350	....	....

[1] Average years 1929 and 1930.



CHEMICAL DATA SHEETS

Wherein we present available statistics for more than 200 important chemical commodities—their production, imports, exports, values. uses, grades and manufacturers

OFTENTIMES in the course of his daily work, the chemical engineer has need for a quick statistical picture of the pertinent facts about a particular chemical commodity. He may want to know how much of it is produced, imported or exported, how much it is worth, or for what it is used. Knowing these things, he invariably asks, "Who makes it?"

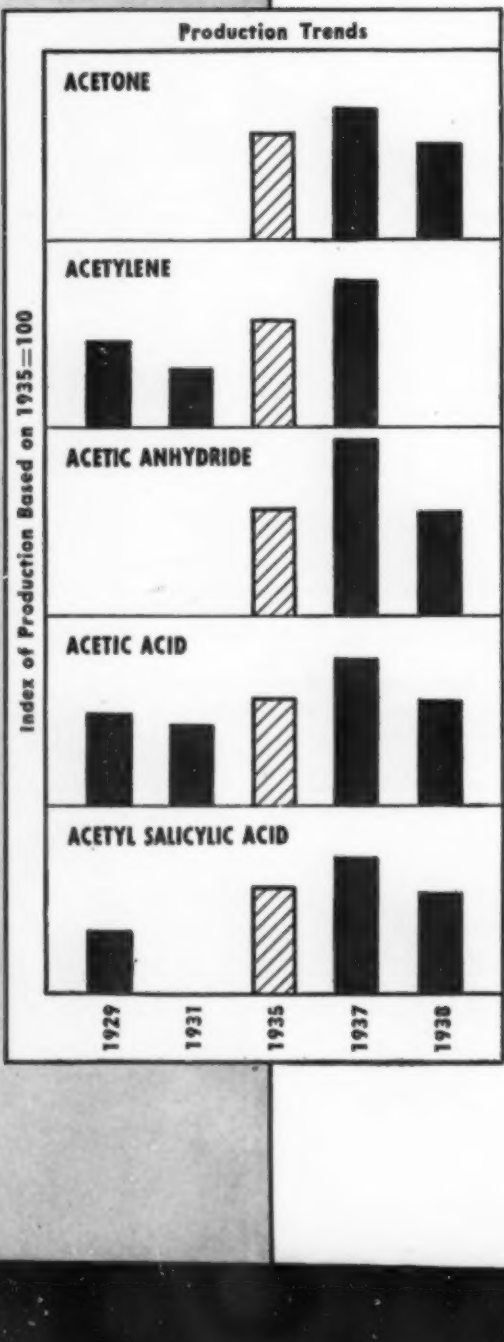
It is just this type of information that has been gathered together by *Chem. & Met.'s* staff and is presented in this handy group of data sheets.

Many sources of information have been consulted. Production data have been gathered from the Census of Manufactures, the U. S. Tariff Commission and the U. S. Bureau of Mines. The unit value of the commodities has been calculated from data reported to these agencies, although for some isolated cases where that information is not available, quoted prices have been substituted. In this connection it is important to emphasize the fact that these average unit values are those actually reported to the government by the manufacturers themselves and may not be directly comparable with quoted prices because of discounts, costs of packaging and delivery, etc.

To facilitate the use of the data sheets, the commodities have been listed in alphabetical order some by their group name, e.g., acids.

Following the word "manufacturers" are several reference numbers. The names of the manufacturers may be found by reference to the corresponding number on pages 596–601.

CURRENT DATA OF CHEMICAL RAW MATERIALS



Year	Production	Imports	Exports	Avg. Value	Uses	Grades
Manufacturers: 73, 108, 116, 133, 329, 357, 407.*						
1938	67,041,184 lb.[1]		11,212,013		Derivatives, dyes, rayon, films, plastics, dopes, varnish, lacquer, alcohol denaturant, general solvent	tech.
1937	84,369,475		9,653,650	3.37¢[2]		C. P.
1935	68,921,870		2,884,386	3.83		U. S. P.
1931			3,845,821			
1929			7,897,230			
Manufacturers: 76, 109, 194, 270, 273, 356.						
1938					Chemicals, indigo, dyes, fuel, welding, cutting metals	tech.
1937	1,511,445 M cu. ft.			12.68¢[3]		
1935	1,148,190			12.90		
1931	742,898			17.38		
1929	969,534			17.07		
Manufacturers: 73, 82, 132, 208, 388.						
1938	114,835,504 lb.		322,371		Chemicals, dyes, dopes, lacquers, varnishes, films, acetates, acetate rayon	tech.
1937	177,488,353		72,724	10.50¢[3]		C. P.
1935	116,460,109			13.00		
1931				15.00		
1929				15.50		
Manufacturers: 82, 99, 108, 116, 126, 133, 154, 162, 168, 203, 209, 218, 261, 281, 286, 343, 358, 388, 389, 402, 406.						
1938	97,478,563 lb.[1,9]	6,355,503	161,312		Acetates, intermediates, esters, dyes, lacquers, pigments, corroding lead, films, resins, rayon, printing, textiles	tech.
1937	131,644,596	31,632,680	149,534	5.02¢[2]		glac.
1935	101,500,662	35,096,288		5.37		U. S. P.
1931	76,401,939	15,291,530		5.65		
1920	86,187,030	29,234,774		10.40		
Manufacturers: 132, 181, 238, 249, 261.						
1938	3,896,066 lb.			53.32¢[2]	Pharmaceutical	U. S. P.
1937	4,997,453			51.02		
1935	4,052,453			55.87		
1931						
1929	2,533,958			78.60		

* For names and addresses of manufacturers, see the Directory of Manufacturers on page 596. Other footnotes appear on page 595

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 80, 133, 181, 184, 261, 381

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Benzoates, aniline dyes, perfume	tech.
1937	125,444 lb.			36.00¢[2]	bases, food preservative, pharma-	C. P.
1935	88,267			38.00	ceutical	U. S. P.
1931						
1929						

Manufacturers: 16, 305, 377, 378.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938			11,191,341		Ceramics, glazes, borates, pre-	tech
1937	40,524,000 lb.	7,334	15,843,776	3.81¢[2]	servative, glass, leather, pharma-	C. P.
1935	28,738,000	29,104	8,761,435	4.34	ceutical, soap, bleaching prep-	U. S. P.
1931	18,127,718	105,338	4,221,490	5.35	arations	
1929	26,055,132	7,472	5,203,881	5.92		

Manufacturers: 127, 133, 162, 178, 265.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Dyes, chrome plating, engraving,	tech.
1937	8,967,337 lb.	2,310		14.01¢[2]	glass, dyeing and printing tex-	U. S. P.
1935	6,723,304	4,281		13.21	tiles, batteries	
1931	3,024,854	1,525		13.99		
1929	4,211,605	462,486		16.87		

Manufacturers: 70, 97, 133, 178, 317.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	10,277,234 lb.[9]				Citrates, flavoring extracts, soft	C. P.
1937	18,138,263	866		22.71¢[2]	drinks, medicine, confectionery	U. S. P.
1935	10,493,068	560		26.40		
1931	8,381,441	90,850		36.51		
1929	10,755,798			44.94		

Manufacturers: 133, 162, 416.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		587,947		10.50¢[2]	Formates, esters, leather, dyeing	tech.
1937		844,203		10.50	and printing, food preservative	U. S. P.
1935		362,333		10.50		
1931		140,063		10.50		
1929		1,386,608		10.75		

Manufacturers: 141, 238, 249, 442.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	140,625 lb.[8]			69.75¢[4]	Gallates, dyes, inks, tanning,	tech.
1937		15,405			engraving, medicine	U. S. P.
1935						
1931						
1929						

Manufacturers: 11, 44, 45, 46, 132, 133, 162, 170, 184, 249, 261, 279, 295, 302, 314, 343, 346.

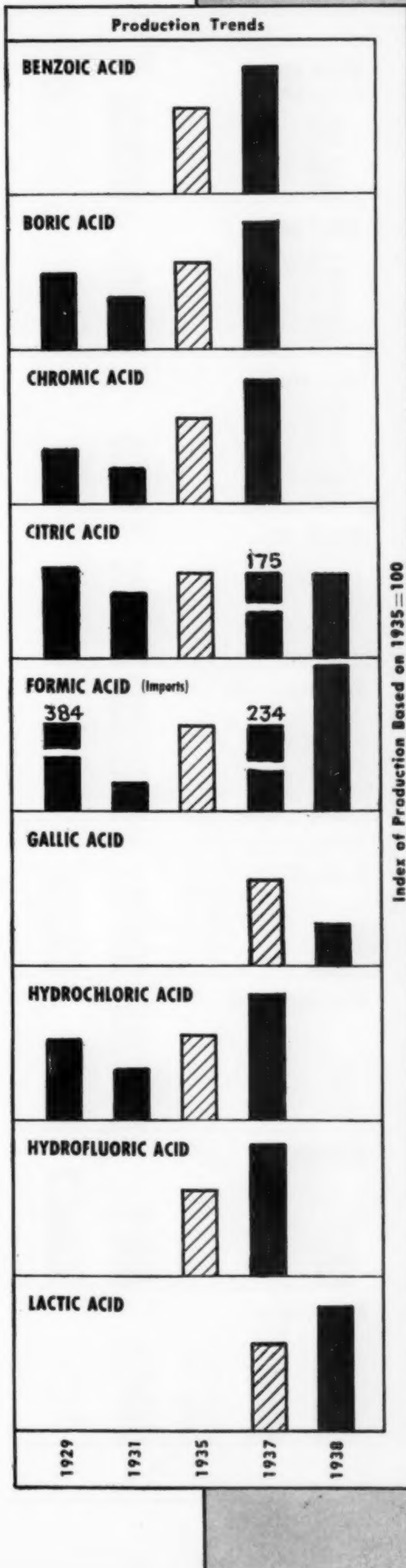
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938			3,148 tons		Chemicals, pickling metals, glue,	
1937	121,473 tons[9]		3,814	$56.18[2]	textiles, dyes, soap, glucose	
1935	87,000	17	3,779	55.53		
1931	54,899		2,000	59.54		
1929	81,307			51.04		

Manufacturers: 133, 162, 178, 227, 314.

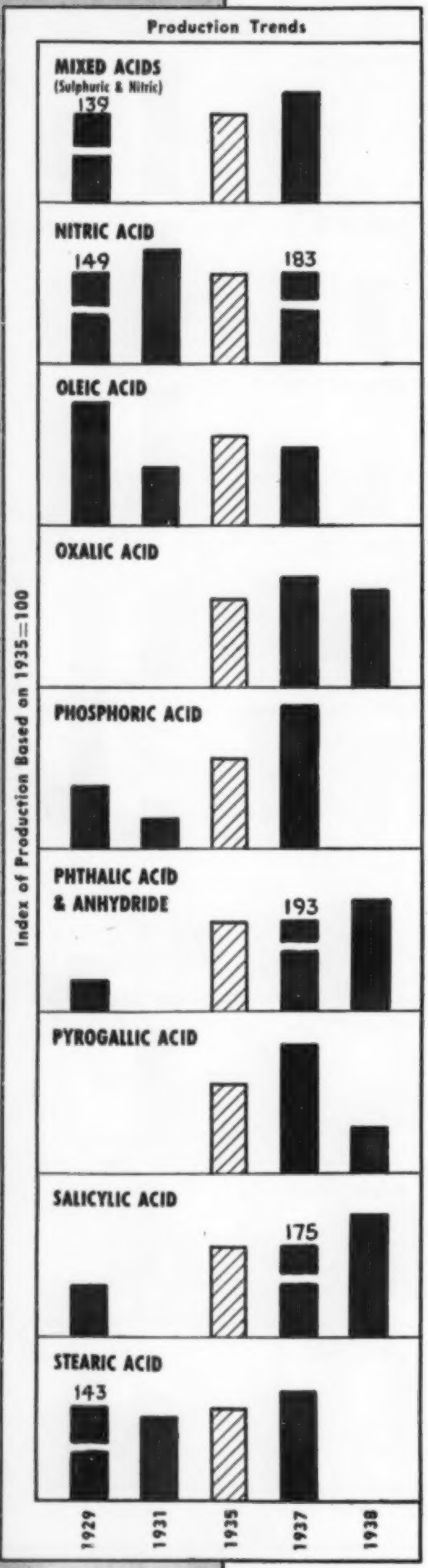
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Brewing, ceramics, glass, chemi-	C. P.
1937	4,395,696 lb.[9]			15.95¢[2]	cals, steel, beet sugar	18° Be
1935	2,993,273	58,652		15.75		20° Be
1931						22° Be
1929						100%

Manufacturers: 14, 28, 101, 133, 350.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	1,292,216 lb.[9]			21.32¢[4]	Lactates, bread, fruit essences,	C. P.
1937	927,329	62,223		22.16	syrups, confectionery, yeast	U. S. P.
1935		113,591				
1931		488,858				
1929		404,315				



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 11, 35, 67, 133, 162, 180, 261, 279, 314, 377, 437.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Explosives, dyes, gun cotton, nitroglycerine, picric acid, nitrating agent	various
1937	54,432 tons	....	....	$45.32[2]		
1935	46,074	....	....	45.60		
1931	....	....	....	....		
1929	63,721	....	....	66.14		

Manufacturers: 11, 35, 67, 128, 141, 162, 180, 261, 279, 314, 346, 437.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Explosives, nitro-cellulose, mixed acids, dyes, chemicals, matches, metallurgical, plastics, textiles	C. P.
1937	175,860 tons[9]	....	....	$86.21[2]		36° Bé
1935	96,109	196	....	87.47		38° Bé
1931	117,240	37	340	107.62		40° Bé
1929	143,454	114	....	106.02		100%

Manufacturers: 84, 123, 144, 171, 176, 276, 328, 435, 437.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	193,724	....	Candles, sprays, leather, oleates, soap, textiles, ointments	dist.
1937	38,086,766 lb.	110,298	181,711	9.46¢[2]		Saponified
1935	43,763,371	....	513,348	7.48		C. P.
1931	29,946,164	....	1,068,073	6.26		
1929	56,947,501	....	3,862,051	9.44		

Manufacturers: 162, 265, 298, 416.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	9,194,738 lb.	569,552	....	10.00¢[4]	Laundries, textiles, bleaching, leather, coal, polishes, cleansers	tech.
1937	10,197,652	218,465	....	10.67[2]		C. P.
1935	8,883,521	78,111	....	10.65[2]		
1931	....	488,996	....	....		
1929	....	1,346,053	....	....		

Manufacturers: 5, 11, 133, 162, 195, 235, 261, 416, 419, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Phosphates and chemicals, dyes, soft drinks, fertilizers, sugar, rust-proofing, textiles, ceramics	50%
1937	78,250,701 lb.[10]	2,469	....	2.28¢[2]		75%
1935	45,385,991	6,461	....	2.94		85%
1931	19,096,150	62,760	....	3.98		U. S. P.
1929	34,673,982	226,819	....	5.98		

Manufacturers: 11, 43, 133, 261, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	27,650,270 lb.	....	....	14.08¢[4]	Intermediates, dyes, esters, perfumes, pharmaceuticals, medicine	tech.
1937	45,210,784	....	....	14.19		pure
1935	23,421,558	....	....	11.74		
1931	....	....	....	....		
1929	9,168,946	....	....	15.41		

Manufacturers: 141, 238, 442.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	51,324 lb.	....	....	....	Dyes, chemicals, photography, engraving, medicine	tech.
1937	118,660	25	....	$1.17[2]		C. P.
1935	86,516	175	....	1.34		U. S. P.
1931	....	125	....	....		
1929	....	12	....	....		

Manufacturers: 132, 133, 181, 261.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	3,330,237 lb.	....	....	26.12¢[4]	Salicylates, esters, drugs, essences, dyes, preservative, medicine	tech.
1937	4,402,889	....	....	26.74		U. S. P.
1935	2,521,350	....	....	28.74		
1931	....	38	....	....		
1929	1,577,758	2,535	....	32.00		

Manufacturers: 83, 84, 123, 144, 171, 174, 176, 276, 328, 425, 435.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	787,952	294,424	....	Stearates, soap, cosmetics, driers, candles, polishes, medicine	saponified
1937	31,888,647 lb.	1,465,046	391,294	11.47¢[2]		dist.
1935	27,438,280	5,507,163	418,770	10.12		Single,
1931	24,868,407	6,318,302	366,979	8.28		double,
1929	39,153,726	....	1,356,735	11.46		triple pressed U. S. P.

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: **For list of sulphuric acid producers, see page —.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	1,390	....	....	Superphosphate, chemicals, iron	50° Bé
1937.....	7,946,695 tons[11]	1,376	....	$7.38[2]	and steel, pigments, explosives,	60° Bé
1935.....	6,432,127	1,050	....	7.11	textiles, petroleum refining, pulp,	66° Bé
1931.....	6,085,242	1,172	1,601	7.82	rubber, coal products	100%
1929.....	8,491,114	8,104	3,480	7.83		oleum

Manufacturers: 11, 86, 228, 442.

1938.....	....	....	....	....	Chemicals, inks, polishes, tan-	tech.
1937.....	1,015,914 lb[9].	49,336	....	37.58¢[2]	ning, dyeing and printing, wines,	C. P.
1935.....	724,552	30,624	....	42.06	medicine	U. S. P.
1931.....	667,212	27,877	....	37.60		
1929.....	1,449,375	123,047	....	34.74		

Manufacturers: 10, 178, 317, 371.

1938.....	....	....	....	....	Tartrates, baking powder, organic	U. S. P.
1937.....	10,642,838 lb.	327,036	....	23.34¢[2]	chemicals, soft drinks, textiles,	C. P.
1935.....	6,887,121	14,821	....	24.82	foodstuffs	tech.
1931.....	5,181,020	2,193,375	....	28.23		
1929.....	4,906,479	3,220,000	....	41.98		

Manufacturers: 88, 108, 133, 155, 212, 249, 354, 406.

1938.....	9,096,977 lb.	....	....	....	Solvent, textiles, varnishes, dyes,	C. P.
1937.....	14,205,997	....	....	....	fruit essences, perfumes	tech.
1935.....	11,002,677	44	....	11.01¢[2]		normal
1931.....	....	10,951	....	....		sec.
1929.....	....	14,840	....	....		tert.

Manufacturers: 73, 88, 108, 133, 155, 293, 329, 357, 370, 406, 407.

1938.....	81,304,789 lb.	....	4,286,386	....	Varnish, japans, esters, chemi-	crude
1937.....	79,933,577	....	3,346,442	7.34¢[2]	cals, dyes, leather, perfumes,	ref.
1935.....	35,877,675	55	2,135,307	7.25	medicine	normal
1931.....	....	20,992	861,140	....		sec.
1929.....	....	5,045	....	....		tert.

Manufacturers: 9, 18, 73, 108, 133, 155, 261, 315, 329, 336, 376, 406.

1938.....	192,670,000	....	....	$4.45[3]	Beverages, denatured alcohol, ex-	U. S. P.
1937.....	215,438,282 gal.	....	....	4.14	tracts, drugs, preservative, foods	abs.
1935.....	193,218,597	1,670	....	4.25		
1931.....	151,464,000	11,175	....	2.45		
1929.....	206.664,000	60,432	....	2.67		

Manufacturers: 11, 133, 162, 180, 261, 314, 380.

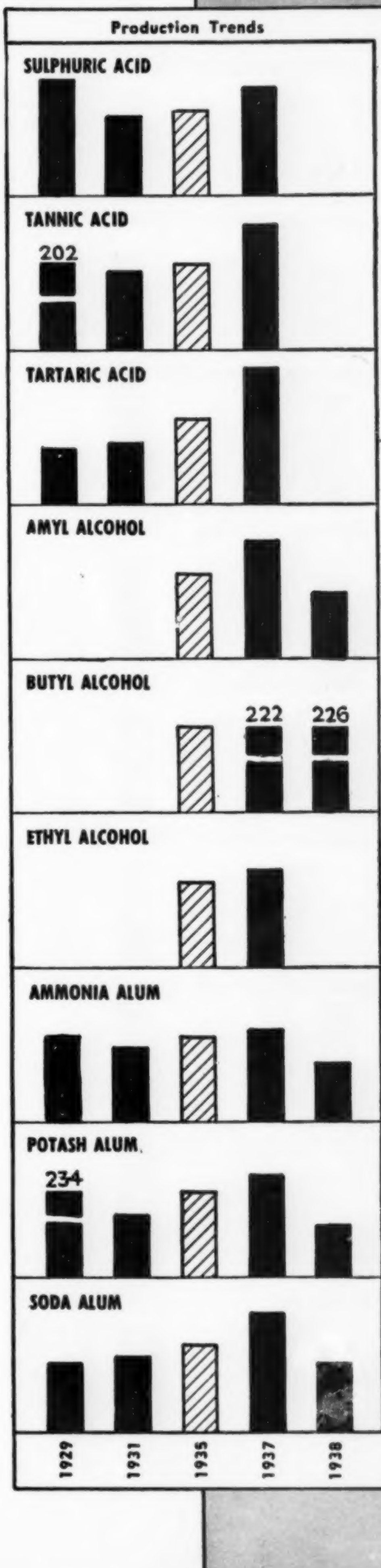
1938.....	3,754 tons	....	....	$53.45[5]	Paper, water purifying, dyeing	tech.
1937.....	5,440	1	....	52.26	and printing, baking powder,	C. P.
1935.....	5,121	....	....	54.01	tanning, fire proofing, medicine	U. S. P.
1931.....	4,668	....	....	53.78		
1929.....	5,108	....	....	56.11		

Manufacturers: 11, 133, 162, 314.

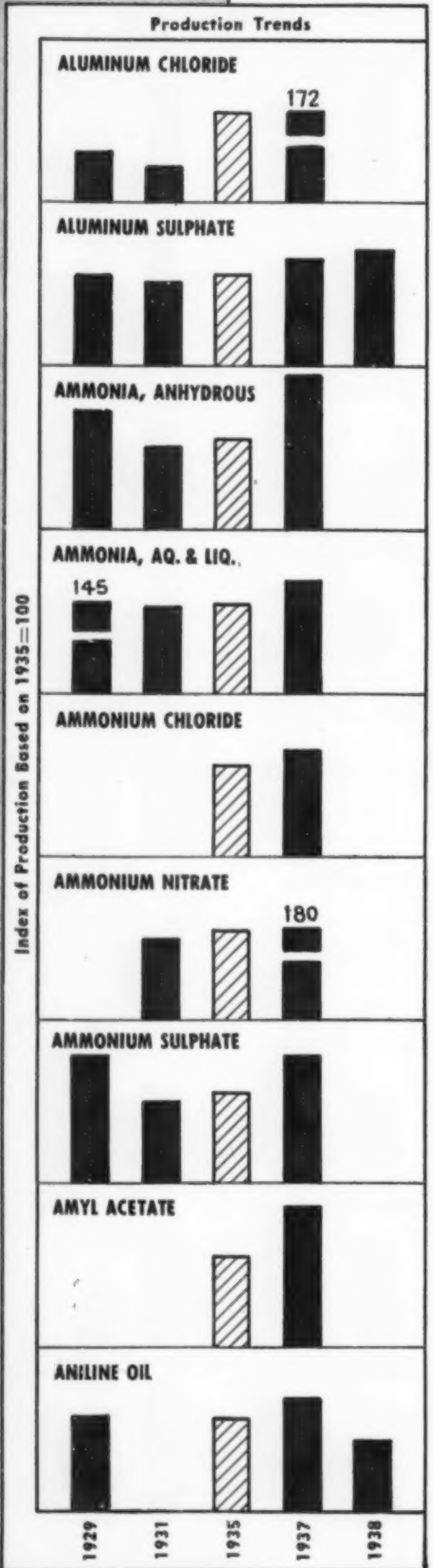
1938.....	1,715 tons	....	....	$58.12[5]	Baking powder, leather, lakes,	tech.
1937.....	3,098	101	....	56.36	paper, sugar, dyeing and printing,	C. P.
1935.....	2,685	....	....	56.27	water proofing	U. S. P.
1931.....	2,086	303	....	53.29		
1929.....	6,304	371	....	40.34		

Manufacturers: 124, 162, 314, 416.

1938.....	24,961 tons	....	....	$54.38[5]	Baking powder, leather, lakes,	tech.
1937.....	24,513	....	....	54.21	paper, dyeing and printing, water	
1935.....	18,216	....	....	57.48	proofing	
1931.....	15,907	....	....	56.95		
1929.....	15,005	....	....	57.00		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 11, 67, 162, 184, 238, 261, 287, 295, 343.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Textiles, oil refining, disinfectant,	tech.
1937	4,034 tons			\$154.60[2]	wood preservative, medicine	anhyd.
1935	2,339			170.00		C. P.
1931	1,099			147.21		U. S. P.
1929	1,521			148.00		

Manufacturers: 11, 133, 162, 180, 261, 314, 343, 377.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	426,961 tons		27,715		Paper, pulp, aluminum salts,	com.
1937	394,438	2,753	31,807	\$22.27[1]	lakes, sizes, tanning, dyeing, oil	N. F.
1935	348,030		33,096	22.27	cloth, purifying water, medicine	C. P.
1931	309,133		27,668	21.58		U. S. P.
1929	344,962		26,108	23.01		

Manufacturers: 32, 36, 43, 59, 133, 170, 245, 256, 261, 267, 304, 314, 357, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938			2,709,815		Refrigerant, organic preparations	tech.
1937	223,040,588 lb.	2,015	2,195,110	3.98¢[2]		Pure
1935	138,778,725		1,623,228	4.09		
1931	127,098,718		1,801,512	6.33		
1929	173,349,355	56	2,416,588	6.16		

Manufacturers: 11, 32, 43, 59, 133, 163, 170, 214, 256, 261, 314, 357, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Organic compounds, intermedi-	tech.
1937	80,633,842 lb.			3.70¢[2]	ates, ammonium salts, nitric acid,	C. P.
1935	65,693,301			3.72	paper, pulp, smelling salts, re-	U. S. P.
1931	64,261,157			4.30	frigerant, medicine	
1929	95,512,437			5.18		

Manufacturers: 11, 133, 170, 314, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		6,583,230			Galvanizing, batteries, ammonia	tech.
1937	39,599,247 lb.	8,448,437		4.60¢[2]	salts, dyes, dyeing and printing,	C. P.
1935	34,864,681	7,855,142		4.54	tanning, medicine	U. S. P.
1931		5,672,472				
1929		9,560,513				

Manufacturers: 35, 43, 133, 180, 249, 398.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		3,330,000			Explosives, nitrous oxide, freez-	tech.
1937	45,560,194 lb.	6,444,227		2.48¢[2]	ing mixtures, matches	C. P.
1935	25,297,894	3,516,697		2.66		
1931	22,948,425	6,705,903		4.06		
1929		9,495,613				

Manufacturers: 5, 11, 43, 132, 162, 193, 214, 249, 314.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		120,837	30,716		Fertilizer, fireproofing, batteries,	com.
1937	747,118 tons	82,853	73,916	\$21.99[2]	chemicals	C. P.
1935	557,986	79,062	78,426	19.40		
1931	508,055	112,215	66,902	25.31		
1929	755,616	18,812	145,189	35.94		

Manufacturers: 88, 108, 133, 150, 155, 212, 261, 293, 320, 354.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938			255,069 lb.		Guncotton, powder, soft drinks,	pure
1937	1,521,997 gal.	405 lb.	378,750	78.11¢[2]	foods, flavors, fireproofing, arti-	tech.
1935	1,025,789			76.95	ficial leather, lacquers, films,	
1931		1,246			textiles	
1929		300				

Manufacturers: 67, 132, 133, 247, 261, 268, 279.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	26,745,862 lb.			10.91¢[4]	Intermediates, colors, dyeing and	com.
1937	38,850,344			11.33	printing, pharmaceuticals, blue-	pure
1935	32,572,809			11.41	prints	C. P.
1931						
1929	33,743,270			12.92		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 17, 23, 202, 409.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	14,238	....	....	Insecticides, weed killer, wood	crude
1937.....	6,878 tons	19,256	....	\$37.25[5]	preservative, glass	ref.
1935.....	6,654	15,075	....	51.50		
1931.....	11,982	7,791	....	60.00		
1929.....	9,823	13,157	....	65.80		

Manufacturers: 42, 90, 375, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Barium salts, ceramics, water	tech.
1937.....	10,753 tons	....	....	\$47.56[2]	purification, dyes, beet sugar,	C. P.
1935.....	7,329	....	....	48.79	reagent	
1931.....	5,687	....	....	44.50		
1929.....	7,902	....	....	56.95		

Manufacturers: 11, 42, 180, 238, 375, 400, 429, 438.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Paper, color lakes, linoleum,	tech.
1937.....	10,396,178 lb.	217,836	....	2.68¢[2]	paints, rubber	C. P.
1935.....	7,809,136	280,000	....	3.02		
1931.....	18,671,982	1,860,082	....	3.51		
1929.....	26,049,893	7,001,690	....	3.68		

Manufacturers: 11, 31, 110, 117, 131, 137, 222, 244, 330, 340.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	455,693	43,759	....	Aluminum, chemicals, abrasives,	crude
1937.....	420,232 tons	507,423	83,745	\$5.82[9]	refractories	ref.
1935.....	237,666	199,959	82,491	6.65		calc.
1931.....	195,896	306,490	88,370	5.82		
1929.....	365,777	380,812	133,551	6.19		

Manufacturers: 43, 67, 129, 133, 193, 207, 214, 249, 280, 291, 325

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	10,613,464 gal.	....	Chemicals, intermediates, paint	pure
1937.....	26,795,497 gal.	....	20,480,711	13.23¢[4]	removers, varnish, lacquer, dopes,	90%
1935.....	24,106,006	....	14,665,639	12.9	cleansing agent, solvent, medicine	C. P.
1931.....	....	8,160,018 lb.	21,861,140	....		U. S. P.
1929.....	25,119,013	18,164,952	33,346,381	20.63		

Manufacturers: 38, 238, 249, 284, 317.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Cosmetics, face powders, ceram-	tech.
1937.....	247,609 lb.	....	....	\$1.27[2]	ics, chemicals, medicine	C. P.
1935.....	231,432	....	....	1.57		U. S. P.
1931.....	161,875	....	....	1.60		
1929.....	140,391	....	....	2.17		

Manufacturers: 38, 238, 284, 317.

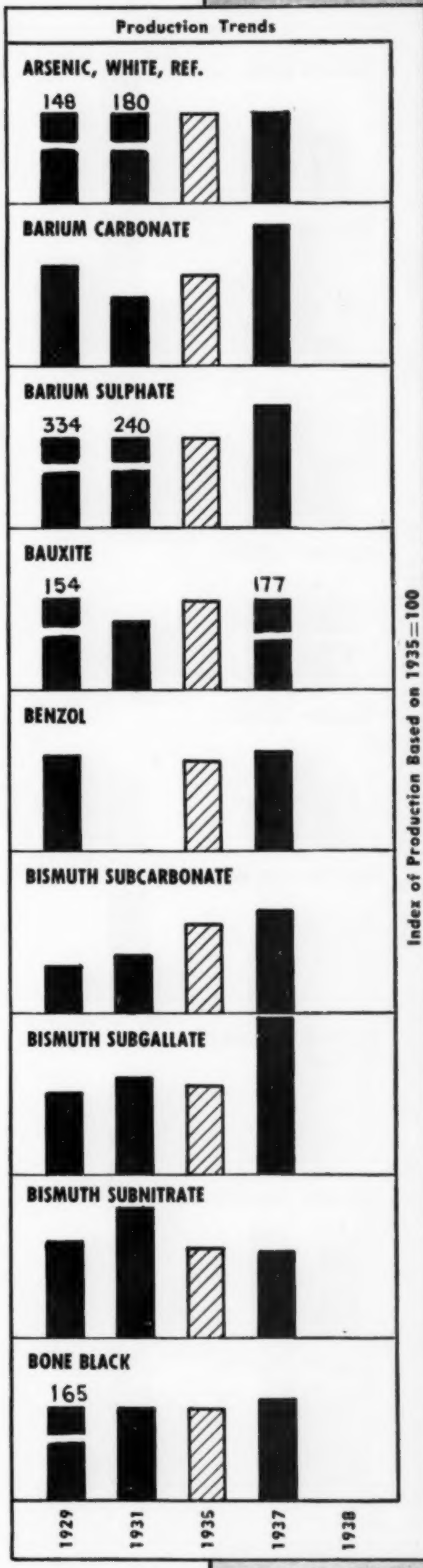
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, perfumes, pharma-	tech.
1937.....	40,861 lb.	....	....	\$1.35[2]	ceuticals	U. S. P.
1935.....	24,328	....	....	1.59		
1931.....	26,394	....	....	1.75		
1929.....	22,946	....	....	2.39		

Manufacturers: 38, 238, 240, 284, 317.

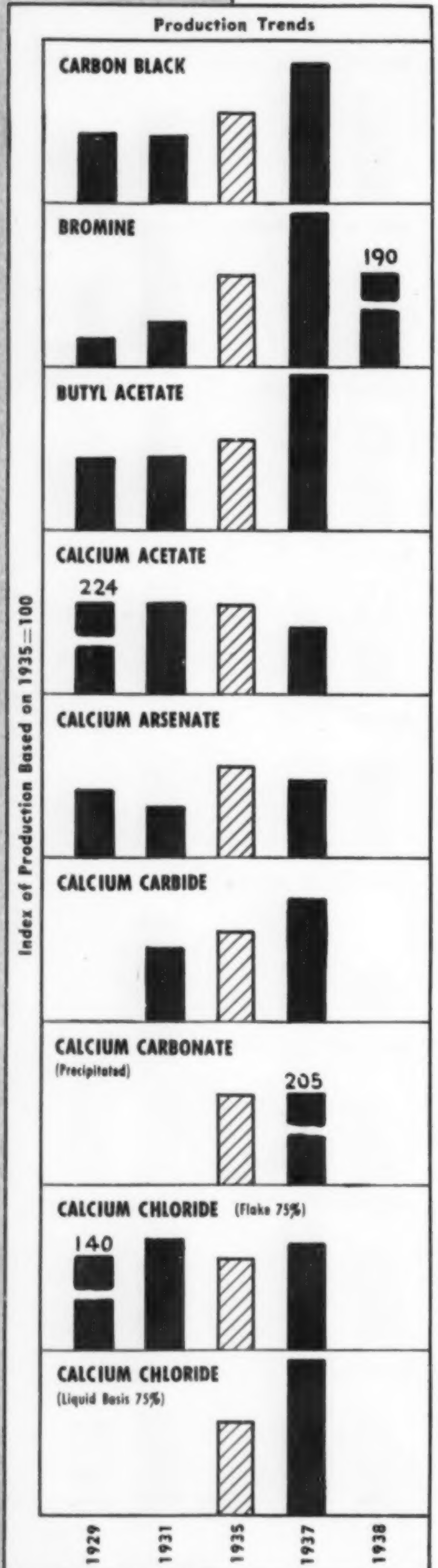
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, cosmetics, perfumes,	tech.
1937.....	262,867 lb.	....	....	\$1.18[2]	ceramics, pharmaceuticals	C. P.
1935.....	269,193	....	....	1.34		U. S. P.
1931.....	373,067	....	....	1.43		
1929.....	280,454	....	....	1.66		

Manufacturers: 5, 32, 44, 53, 87, 242, 400.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	1,134,240	....	Filtering, decolorizing, polishes,	tech.
1937.....	35,571,397 lb.	....	1,701,877	4.83¢[2]	gas masks, sugar, water purifica-	
1935.....	32,922,190	....	1,385,112	3.98	tion	
1931.....	33,214,240	161,150	2,773,088	3.88		
1929.....	54,277,051	1,191,706	3,200,513	4.59		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 52, 107, 111, 115, 186, 189, 206, 237, 262, 311, 392, 404, 438.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	167,968,316	.....	Rubber, paints, printing inks,	tech.
1937	510,606,343 lb.	.....	184,029,552	3.41¢[2]	paper, polishes, crayons, cements,	
1935	352,749,000	.....	142,184,802	3.90	typewriter ribbons	
1931	280,907,000	.....	96,714,116	3.07		
1929	283,806,000	.....	91,829,425	6.00		

Manufacturers: 130, 145, 169, 229, 254, 263, 297, 334, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	32,324,116 lb.	.....	.....	20.40¢[5]	Bromides, gases, dyes, pharma-	tech.
1937	26,200,256	25	.....	19.77	ceuticals, disinfectant, extracting	C. P.
1935	16,428,533	.....	.....	21.20	gold, refining platinum	U. S. P.
1931	8,935,330	25	.....	20.76		
1929	6,414,620	17,573	.....	27.43		

Manufacturers: 73, 88, 108, 133, 208, 261, 315, 329, 357, 370, 407.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	4,143,737 lb.	.....	Lacquers, leather, films, plastics,	normal
1937	9,316,128 gal.	.....	3,940,577	54.58¢[4]	flavors, solvent, perfumes	sec.
1935	5,631,056	.....	.....	65.47		
1931	4,063,966	.....	.....	74 87		
1929	4,523,863	7,824,234 lb.	.....	$1.26		

Manufacturers: 60, 98, 120, 126, 163, 168, 179, 201, 209, 213, 225, 300, 301, 313, 316, 402, 432.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	.....	.....	Chemicals, dyeing and printing	tech.
1937	22,517 tons	.....	.....	$32.28[2]		pure
1935	25,851	.....	.....	31.93		C. P.
1931	25,796	207	.....	33.72		
1929	58,163	12,292	56	80.73		

Manufacturers: 3, 5, 72, 91, 132, 133, 162, 218, 289, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	5,242,882	.....	Insecticide, fungicide, germicide.	tech.
1937	37,001,959 lb.	796,243	5,384,560	5.08¢[2]		C. P.
1935	43,295,354	182,900	4,104,810	5.36		
1931	26,128,620	40,950	2,145,653	4.90		
1929	33,064,426	.....	3,139,633	5.63		

Manufacturers: 258, 269, 275, 401.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	1,991	.....	Chemicals, dehydrating agent,	tech.
1937	193,045 tons	754	2,415	$51.00[2]	steel, fertilizer	
1935	147,092	242	2,248	42.38		
1931	128,263	206	2,417	62.56		
1929	.....	1,852	2,172	.....		

Manufacturers: 106, 129, 133, 238, 430.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	.....	.....	Tooth paste, cement, ceramics,	tech.
1937	71,236 tons	.....	.....	$23.41[2]	chemicals, mineral waters, medi-	C. P.
1935	33,971	.....	.....	25.31	cine	U. S. P.
1931	.....	.....	.....	.....		
1929	.....	.....	.....	.....		

Manufacturers: 5, 59, 106, 129, 130, 132, 133, 229, 231, 254, 297, 314, 324, 334, 361, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	24,118[7]	.....	Chemicals, sizes, preservative,	tech.
1937	223,641 tons	2,205[7]	21,731	$16.78[2]	refrigerating solutions, dust layer,	C. P.
1935	197,948	2,004	30,736	16.20	fire proofing	U. S. P.
1931	232,057[12]	4,916	24,351	20.36		
1929	277,010	8,236	15,425	21.47		

Manufacturers: See Calcium Chloride, Flake.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	.....	.....	.....	.....	Chemical, fireproofing, refrigerat-	tech.
1937	35,080 tons	.....	.....	$9.74[2]	ing, color lakes, dehydrating,	C. P.
1935	21,527	.....	.....	14.61	metallurgical	U. S. P.
1931	.....	.....	.....	.....		
1929	.....	.....	.....	.....		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: See Calcium Chloride, Flake.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Chemicals, metallurgical, dehydrating agent	tech.
1937	4,822 tons	....	....	$17.74[2]		C. P.
1935	7,526	....	....	14.42		U. S. P.
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 62, 143, 170, 184, 194, 245, 261, 314, 377.

1938	....	930	....	....	Textiles, laundries, pulp, water works, germicide, disinfectant, tanning	tech.
1937	45,908 tons	1,077	....	$20.41[2]		U. S. P.
1935	39,561	1,386	....	22.98		
1931	63,793	1,009	860	32.51		
1929	93,116	1,396	2,512	35.98		

Manufacturers: 5, 11, 56, 133, 162, 261, 348, 416, 419.

1938	....	....	....	....	Baking powder, fertilizer, medicine	tech.
1937	38,708 tons	....	....	$128.14[2]		C. P.
1935	35,860	....	....	130.10		
1931	36,454	....	....	138.75		
1929	38,139	....	....	145.72		

Manufacturers: 5, 56, 162, 238, 261, 416, 437.

1938	....	....	....	....	Baking powder, fertilizer, dentistry, medicine	tech.
1937	5,138 tons	....	....	$94.26[2]		C. P.
1935	4,729	....	....	95.22		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 1, 15, 35, 73, 99, 122, 430.

1938	....	....	....	....	Decolorizing, filter, gas absorbtion, clarifying, deodorizing	various
1937	10,655 tons	....	....	$135.22[2]		
1935	11,477	....	....	80.65		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 38, 132, 133, 162, 314, 377, 429.

1938	....	....	3,936,206	....	Rayon, solvent, preservative, carbon tetrachloride, insecticide, matches	tech.
1937	155,237,735 lb.	....	5,881,538	3.06¢[2]		U . S. P.
1935	117,757,762	....	4,397,881	2.80		
1931	83,045,219	....	2,090,855	3.85		
1929	71,009,798	....	....	4.03		

Manufacturers: 7, 38, 68, 74, 75, 106, 108, 119, 155, 228, 261, 271, 294, 307, 315, 365, 367, 423, 424, 441.

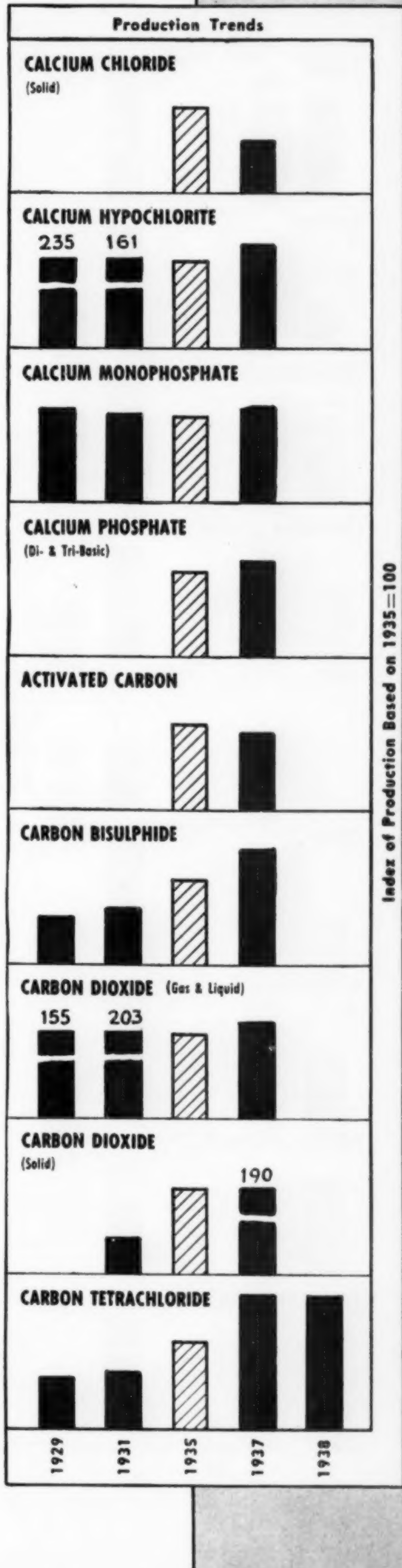
1938	....	....	....	....	Beverages, refrigeration, urea, fire extinguishers, fumigants	tech.
1937	100,715,662 lb.	308,460	....	4.90¢[2]		Pure
1935	87,657,446	377,294	....	5.18		
1931	180,471,183	50,845	....	4.05		
1929	136,930,311	....	....	5.06		

Manufacturers: 7, 12, 228, 245, 253, 271, 307, 365, 441.

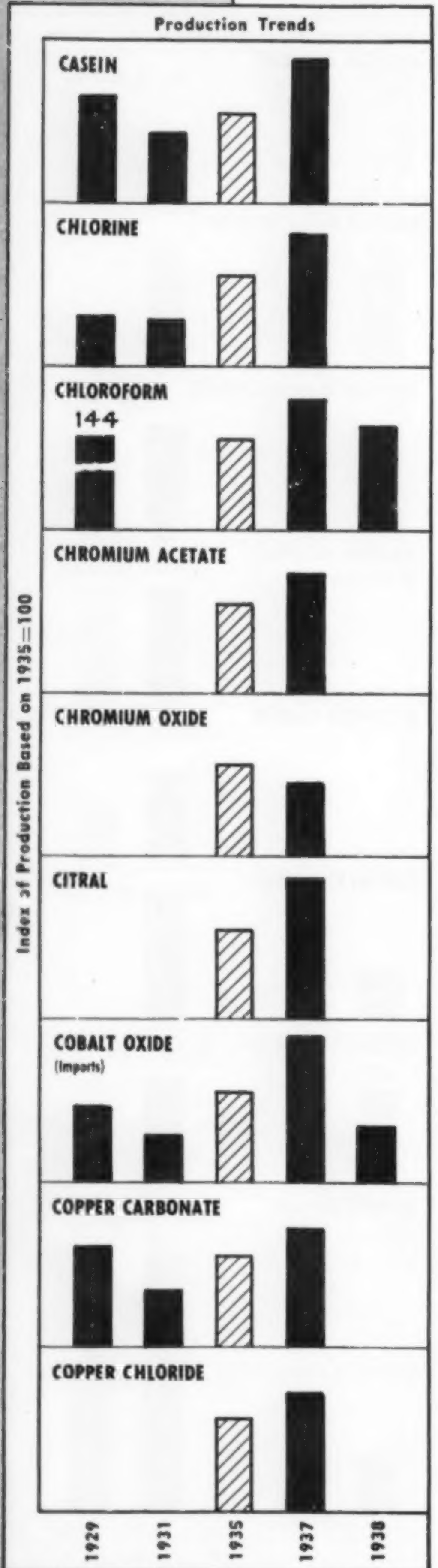
1938	....	....	....	....	Refrigeration, fire extinguishers, low-freezing, lubricating oils	tech.
1937	313,217,310 lb.	....	....	1.48¢[2]		
1935	165,123,912	....	....	1.97		
1931	84,954,018	56,845	....	3.41		
1929	....	....	....	....		

Manufacturers: 38, 129, 132, 133, 170, 288, 314, 377, 429.

1938	77,975,057 lb.	....	....	....	Solvent, fire extinguisher, cleanser, chloroform, chlorinating agent	tech.
1937	78,708,690	....	....	3.90¢[2]		C. P.
1935	51,970,367	....	....	4.14		U. S. P.
1931	34,095,802	....	492,000	5.04		
1929	32,712,749	20	....	5.28		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 71, 81, 93, 121, 180, 216, 272, 274, 356, 399, 434.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	417,366	....	....	Paints, paint removers, adhesives, paper, plastics, textiles, edible trades	dry
1937	77,172,294 lb.	5,209,928	....	10.83¢[2]		tech.
1935	48,976,969	3,229,706	....	8.73		edib.
1931	41,375,639	3,503,249	....	5.47		
1929	57,826,167	27,583,339	....	9.90		

Manufacturers: 33, 46, 62, 106, 129, 132, 133, 143, 170, 180, 184, 245, 253, 261, 286, 314, 361, 363, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	4,743	....	Chemicals, pulp, paper, water purification, dyes, gases, rubber substitutes, textiles, germicide, deodorant	tech.
1937	446,261 tons	....	4 295	$36.43[2]		
1935	315,139	....	5,803	38.39		
1931	180,870	....	4,421	41.08		
1929	199,472	....	3,584	49.08		

Manufacturers: 46, 62, 132, 133, 170.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	2,159,933 lb.	....	....	18.28¢[4]	Dyes, pharmaceuticals, solvent, medicine	tech.
1937	2,657,167	3	....	17.22		C. P.
1935	1,919,972	....	....	18.01		U. S. P.
1931	....	....	....	....		
1929	2,767,301	30	....	19.62		

Manufacturers: 11, 278, 285, 439.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Dyeing and printing, tanning, chrome salts, acetate rayon	tech.
1937	811,587 lb.	....	....	4 62¢[2]		C. P.
1935	630,023	....	....	5.58		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 25, 133, 136, 182, 190, 210, 220, 248, 275, 358, 405, 427.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Chemicals, dyes, paint, rubber, cement, dyeing and printing, glass, ceramics	tech.
1937	2,875,060 lb.	....	....	20.97¢[2]		C. P.
1935	3,480,585	....	....	21.74		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 133, 150, 151, 234, 381, 412.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Flavors, extracts, perfumes....	....
1937	17,175 lb.	....	....	$1.65[2]		
1935	11,340	....	....	1.91		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 38, 133, 178.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	373,215	....	$1.67[3]	Paint, varnish, glass, ceramics..	tech.
1937	....	842,847	....	1.67		
1935	....	557,083	....	1.32		
1931	....	318,391	....	1.60		
1929	....	475,928	....	2.10		

Manufacturers: 91, 112, 133, 178, 264, 322, 387.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Pigment, copper salts, pyrotechnics, ceramics, insecticides, metallurgical	tech.
1937	811,163 lb.	....	....	14.95¢[2]		
1935	638,425	....	....	14.03		
1931	405,306	....	....	13.39		
1929	675,436	....	....	18.24		

Manufacturers: 112, 162, 178, 238, 249.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Chemicals, pharmaceuticals, metallurgy, rayon, insecticide	tech.
1937	95,452 lb.	....	....	20.57¢[2]		C. P.
1935	77,290	....	....	12.57		
1931	....	....	....	....		
1929	....	....	....	....		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 11, 133.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Chemicals, electroplating, medicine	tech.
1937	738,683 lb.			35.78¢[2]		C. P.
1935	473,492			35.81		
1931						
1929						

Manufacturers: 38, 47, 78, 133, 166, 183, 249, 318, 343.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938					Paint, rayon, ceramics, glazes, electric batteries, chemicals, electroplating, germicide	tech.
1937		2,240				C. P.
1935	1,169,875 lb.			18.76¢[2]		
1931	499,019	59,614		12.97		
1929	825,280	252,767		20.70		

Manufacturers: 17, 72, 90, 133, 200, 231, 264, 290, 318, 337, 387.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		201,300	31,249,735		Chemicals, fungicide, dyes, pigments, water purification, rayon, engraving, dyeing and printing, medicine	tech.
1937	78,892,091 lb.	90,287	23,528,240	4.92¢[2]		C. P.
1935	54,759,439	57,772	4,508,271	3.66		
1931	60,981,335	2,643,891	7,190,919	3.58		
1929	78,669,112	5,388,743	6,419,688	5.52		

Manufacturers: 132, 133, 151, 165, 247, 261.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	138,357 lb.			$2.51[4]	Flavors, perfumes, soap, tobacco	pure
1937	216,767			2.62		
1935	133,022			2.59		
1931						
1929	108,326			3.28		

Manufacturers: 21, 43, 49, 113, 118, 140, 187, 193, 205, 211, 214, 221, 280, 291, 338, 339, 347.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938		55,391,590	532,545		Wood preserving	tech.
1937	107,293,751 gal.	58,189,527	664,976	11.60[9]		
1935	92,869,152	34,513,486	349,220	10.20		
1931		36,884,900	1,872,545			
1929	170,476,958	79,300,575		9.00		

Manufacturers: 43, 67, 118, 166, 181, 214, 338, 381.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	11,403,429 lb.			8.53¢[4]	Chemicals, resins, photography, disinfectants, paint remover, reclaiming rubber, medicine	tech.
1937	13,745,271			8.09		U. S. P.
1935						
1931		151,571				
1929		227,974				

Manufacturers: 11, 73, 108, 133, 208, 212 261, 407.

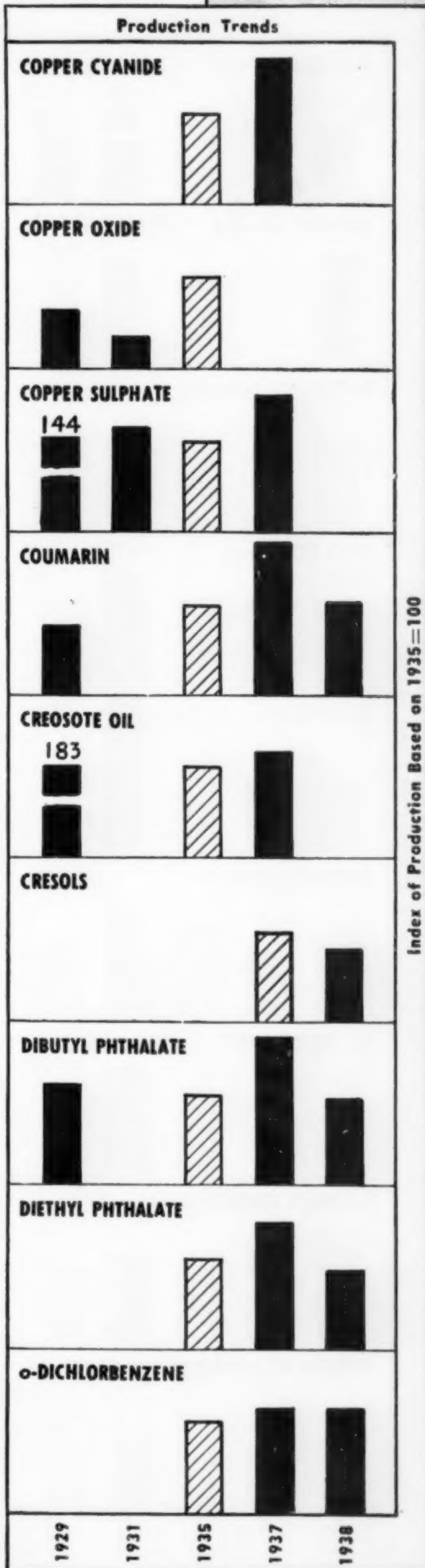
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	4,206,475 lb.				Lacquers, plastics, perfumes	tech.
1937	6,963,625			17.12¢[4]		
1935	4,412,724			18.93		
1931						
1929	4,749,776			25.20		

Manufacturers: 11, 108, 208, 261, 407.

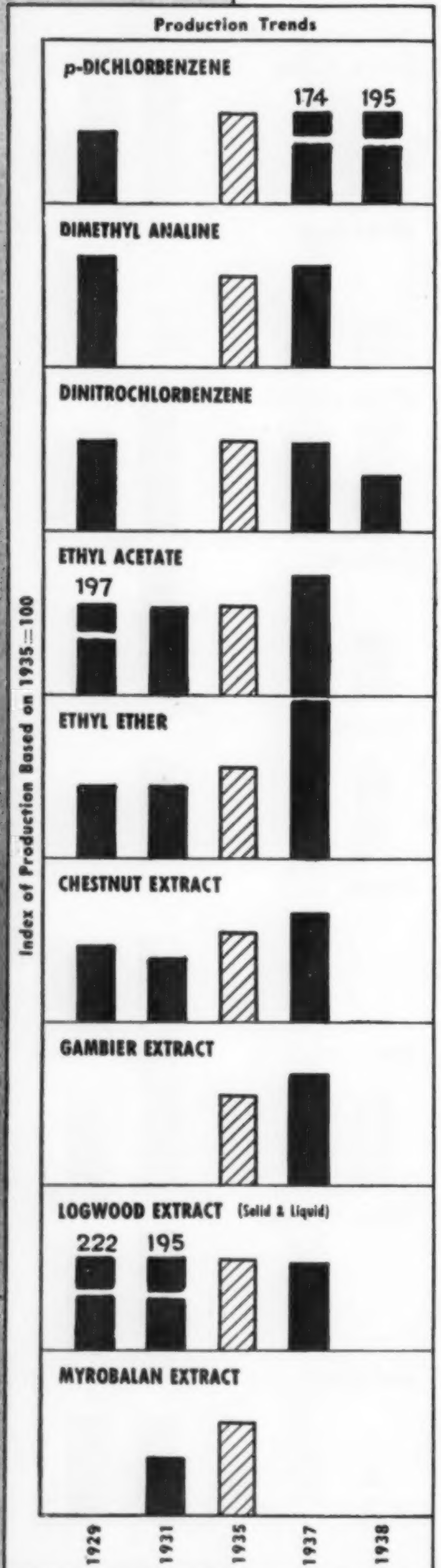
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	870,283 lb.				Plasticizer, perfumes, celluloid, solvent, textiles	tech.
1937	1,288,491			17.47¢[4]		pure
1935	934,489			18.01		
1931						
1929						

Manufacturers: 132, 133, 184, 261, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	3,290,355 lb.			5.58¢[4]	Dyes, intermediates, organic chemicals, lacquers, fumigation	tech.
1937	3,209,179			5.11		
1935	2,904,641			3.62		
1931						
1929						



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 132, 133, 184, 261, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	13,061,206 lb.	....	....	8.53¢[4]	Dyes, intermediates, chemicals, insecticides, deodorant	tech.
1937.....	11,705,376	....	....	9.84		
1935.....	6,830,350	....	....	11.06		
1931.....	....	....	....	....		
1929	5,616,475	....	....	14.43		

Manufacturers: 67, 133, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, pharmaceuticals, methylene blue, rubber vulcanization	tech.
1937.....	3,510,106 lb.	....	....	....		
1935.....	3,241,305	....	....	22.00¢[3]		
1931.....	....	....	....	....		
1929.....	3,831,006	....	....	....		

Manufacturers: 67, 133, 161, 261, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	4,965,771 lb.	....	....	....	Dyes, chemicals, perfumes.....	tech.
1937	7,009,768	....	....	....		
1935.....	7,384,556	....	....	11.00¢[4]		
1931.....	....	....	....	....		
1929.....	7,317,164	....	....	....		

Manufacturers: 73, 108, 133, 153, 261, 315, 328, 407.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, dyes, plastics, flavors, perfumes, varnish, dopes, films, rayon, esters	anhy.
1937.....	6,946,081 gal.	....	....	42.03¢[2]		ref.
1935.....	5,563,199	....	....	48.16		tech.
1931.....	5,457,495	2,249 lb.	....	44.89		
1929	10,932,225	74	....	82.40		

Manufacturers: 73, 133, 238, 249, 407.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Intermediates, chemicals, rayon, dyes, solvent, perfumes, denaturant, resins, medicine	C. P.
1937.....	13,097,484 lb.	27	....	12.61¢[2]		U. S. P.
1935.....	7,915,299	....	....	16.48		
1931.....	6,981,845	500	....	21.08		
1929.....	6,463,552	2,262	....	29.35		

Manufacturers: 13, 385, 386, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	3,174,833	....	Tanning, dyeing and printing...	tech.
1937.....	363,706,338 lb.	....	1,588,375	1.37¢[2]		
1935.....	302,842,353	....	5,931,211	1.51		
1931.....	227,539,138	....	1,633,912	1.42		
1929.....	270,162,089	57,500	5,065,458	1.48		

Manufacturers: 11, 13, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	2,989,894	....	....	Tanning, dyeing and printing...	tech.
1937.....	777,722 lb.	4,615,866	....	6.89¢[2]		
1935.....	660,694	4,484,120	....	6.21		
1931.....	....	2,257,613	....	....		
1929.....	....	5,277,113	....	....		

Manufacturers: 11, 13, 385, 386, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	6,291 tons	605,115 lb.	....	Dyeing, tanning........	liq.
1937.....	8,215,460 lb.	17,031	682,610	10.13¢[2]		solid
1935.....	8,706,466	11,384	1,020,801	8.55		
1931.....	17,031,756	21,863	1,601,882	7.34		
1929.....	19,337,708	28,155	2,025,351	9.53		

Manufacturers: 11, 13, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	6,907 tons	....	....	Tanning, dyeing and printing...	liq.
1937	....	20,587	....	....		solid
1935.....	3,473,508 lb.	12,276	....	2.34[2]¢		
1931.....	2,265,579	11,326	....	2.93		
1929.....	....	16,504	....	....		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 385, 386, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Tanning........................	tech.
1937.....	12,698,305 lb.	....	....	2.73¢[2]		
1935.....	11,075,522	....	....	2.44		
1931.....	5,123,001	....	....	3.27		
1929.....	7,826,963	....	....	3.77		

Manufacturers: 11, 13, 385, 386, 394, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	85,228,095	....	....	Tanning, dyeing and printing...	liq.
1937.....	....	142,412,184	....	....		solid
1935.....	81,226,104 lb.	110,438,725	....	1.73¢[2]		
1931.....	76,469,460	90,236,947	....	2.43		
1929.....	100,066,938	82,377,112	....	3.22		

Manufacturers: 11, 13, 385, 386, 440, 442.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	1,105 ton	....	....	Tanning........................	tech.
1937.....	3,538,350 lb.	1,596	....	4.78¢[2]		
1935.....	3,551,769	2,523	....	5.74		
1931.....	5,809,278	2,960	....	6.36		
1929.....	5,279,069	3,579	....	6.51		

Manufacturers: 96, 133, 181.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	1,764,577	5.75¢[3]	Plastics, chemicals, dyes, syn-	tech.
1937.....	....	....	2,864,872	5.75	thetic resins, embalming fluids,	C. P.
1935.....	....	....	2,497,810	6.00	preservatives, disinfectant, phar-	U. S. P.
1931.....	....	....	2,904,847	6.00	maceuticals	
1929.....	51,786,422 lb.	....	2,588,169	9.00		

Manufacturers: 13, 385, 386, 440.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Tanning, dyeing..............	liq.
1937.....	1,222,028 lb.	....	....	8.74¢[2]		
1935.....	1,359,698	....	....	7.38		
1931.....	....	4,196,508	....	....		
1929.....	....	5,528,320	....	....		

Manufacturers: 133, 150, 151, 159, 243, 381, 307, 412.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	300,717 lb'	147,320	....	62.55¢[4]	Perfumes.....................	tech.
1937.....	166,942	133,939	....	75.96		
1935.....	111,096	123,261	....	$1.33		
1931.....	74,908	139,702	....	1.73		
1929.....	94,743	89,738	....	2.58		

Manufacturers: 32, 84, 123, 144, 149, 171, 174, 176, 217, 232, 328.

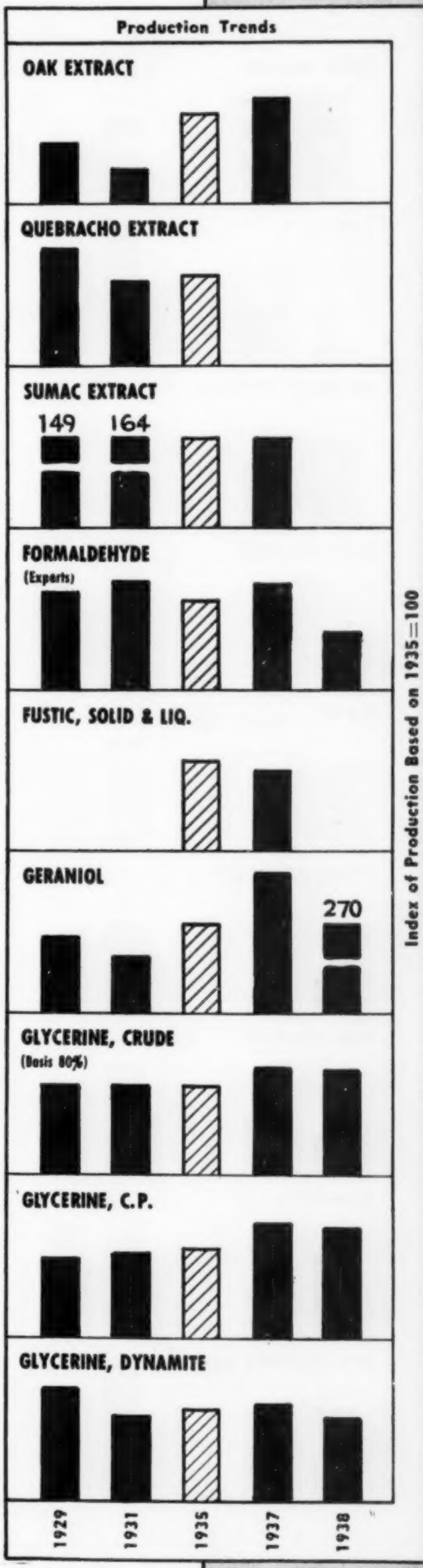
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	162,120,070 lb.	13,007,525	3,746,217[7]	....	Production of refined glycerine,	crude
1937.....	169,038,709	13,598,403	1,355,036	10.72¢[2]	soap, shoe blacking	soap-lye
1935	141,184,825	8,220,934	3,353,625	8.96		
1931	140,001,604	9,951,473	328,143	6.08		
1929.....	140,079,568	14,601,736	1,373,605	8.19		

Manufacturers: 32, 104 223, 249, 328.

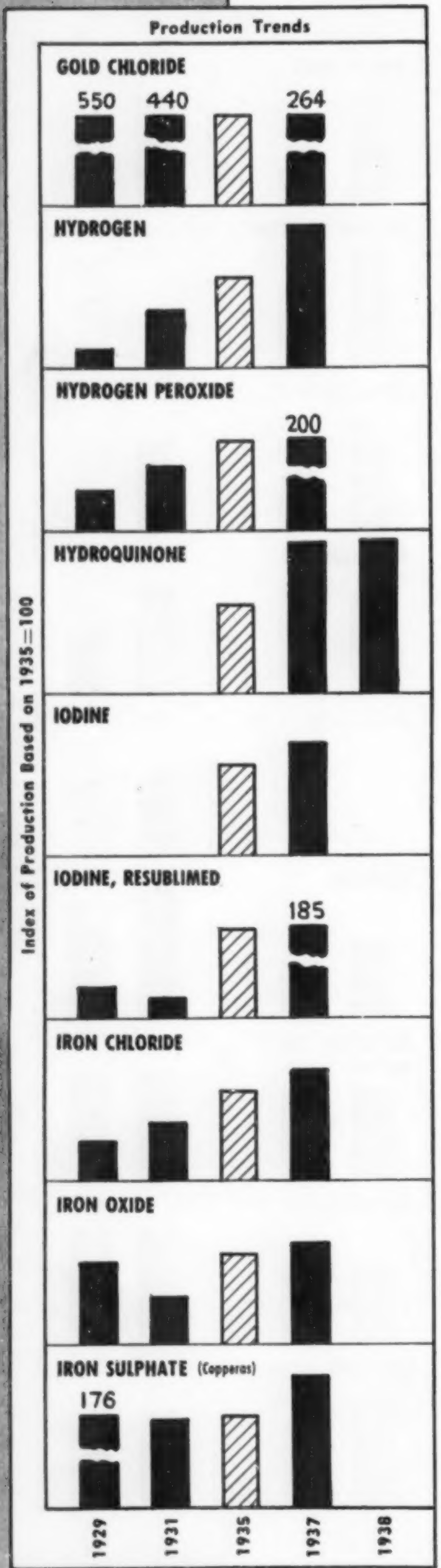
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	91,326,551 lb.	2,567,411	....	....	Pharmaceuticals, cosmetics, food,	C. P
1937.....	92,889,111	7,378,147	....	17.08¢[2]	tobacco, perfumes, fermented	U. S. P.
1935.....	74,704,505	68,566	....	....	drinks	
1931.....	70,527,961	1,975,970	....	....		
1929.....	66,790,647	5,493,471	....	....		

Manufacturers: 83, 104, 223, 328, 425.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	43,613,526 lb.	....	....	....	Nitroglycerine, solvent, printing	dyn.
1937.....	51,793,568	....	....	17.95¢[2]	ink rolls, low-freezing dynamite,	
1935.....	48,685,282	....	....	....	paper, plastics, anti-freeze	
1931.....	43,366,048	....	....	....		
1929.....	58,981,430	....	....	....		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 238, 249.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Glass, ink, photography, medicine	tech.
1937	2,903 oz.	....	....	$19.98[2]		
1935	1,102	....	....	22.15		
1931	4,832	....	....	11.15		
1929	6,016	....	....	12.14		

Manufacturers: 2, 11, 46, 76, 109, 143, 184, 223, 226, 244, 273, 296, 314, 332.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Chemicals, oils and fats, welding, balloons, hydrogenating agent, metallurgy, tungsten lamps	tech.
1937	1,103,177 M cu. ft.	....	....	1.68¢[2]		pure
1935	743,860	....	....	2.00		
1931	493,518	....	....	1.94		
1929	207,843	....	....	6.85		

Manufacturers: 41, 64, 133, 238, 249, 314, 420.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Textiles, disinfectant, brewing, chemicals, dyes, food, leather, general bleaching agent, medicine	tech.
1937	35,040,378 lb.[13]	....	188,314	18.13¢[2]		U. S. P.
1935	17,409,092	....	459,657	18.12		
1931	12,853,651	77,402	1,319,743	25.62		
1929	8,508,649	145,403	2,237,940	27.88		

Manufacturers: 80, 133, 141, 415, 442.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	1,246,671 lb.	....	....	86.24¢[4]	Chemicals, dyes, drugs, photography	tech.
1937	1,220,253	....	....	72.04		U. S. P.
1935	769,106	....	....	74.08		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 125, 198.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	570,532	....	....	Chemicals, dyes, pharmaceuticals, germicide	C. P.
1937	299,286 lb.	1,967,148	....	81.00¢[5]		U. S. P.
1935	245,606	375,819	....	$1.01		
1931	....	278,713	....	....		
1929	....	627,162	....	....		

Manufacturers: 38, 162, 238, 249, 317.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Medicine	U. S. P.
1937	369,270 lb.	....	....	$1.08[2]		
1935	199,816	....	....	1.19		
1931	66,735	....	....	4.57		
1929	87,102	....	....	4.74		

Manufacturers: 11, 90, 112, 129, 132, 133, 162, 170, 184, 194, 238, 261.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Chemicals, pigments, pharmaceuticals, photo-engraving, water purification, sewage treatment	tech.
1937	13,577,650 lb.	....	....	2.75¢[2]		C. P.
1935	11,318,416	....	....	2.58		
1931	7,764,867	812,956	....	2.99		
1929	5,941,289	842,458	....	4.93		

Manufacturers: 11, 133, 178, 236, 249, 259, 327, 382, 436, 438.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	16,718,261	11,395,849	....	Mineral colors, rouge, paints, textiles, oilcloth, linoleum, rubber, medicine	tech.
1937	128,891,324 lb.	29,587,274	13,478,002	3.16¢[2]		
1935	112,423,238	32,519,608	27,952,611	2.74		
1931	64,212,191	24,085,190	16,612,378	3.03		
1929	105,627,130	46,419,570	41,959,784	3.09		

Manufacturers: 11, 20, 133, 162, 166, 173, 178, 314, 342, 377.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Iron salts, dyeing and printing, sewage, water purification, tanning, inks, medicine	tech.
1937	45,150 tons	....	....	$10.34[2]		C. P.
1935	31,852	....	....	9.78		U. S. P.
1931	30,669	....	....	9.14		
1929	56,047	....	....	9.88		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 38, 133, 162, 182, 249, 275, 343, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Lead salts, driers, printing inks,	tech.
1937.....	1,957,811 lb.	....	....	10.51¢[2]	paper, pigments, dyeing and	C. P.
1935.....	3,360,067	....	....	7.52	printing, water proofing	U. S. P
1931.....	454,963	333,295	....	12.31		
1929.....	2,084,364	385,331	....	12.27		

Manufacturers: 3, 5, 38, 72, 91, 132, 133, 162, 218, 231, 249, 280, 322, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	1,021,345	....	Insecticide..	tech.
1937	63,291,440 lb.	551	1,042,880	8.75¢[2]		
1935.....	52,145,851	....	1,156,922	8.00		
1931	37,974,038	....	1,788,345	9.67		
1929.....	30,682,379	200	1,563,982	11.48		

Manufacturers: 133, 146, 147, 166, 275, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	30,813 tons	....	807	$137.00[6]	Batteries, paints, ceramics	tech.
1937.....	33,931	....	934	160.00		
1935.....	28,776	5	750	121.00		
1931.....	25,853	1	....	129.00		
1929.....	43,021	....	....	176.00		

Manufacturers: 135, 275.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	5,801 tons	....	....	$110.00[5]	Paints, enamels, zinc oxide,	tech.
1937.....	8,622	....	....	130.00	ceramics	
1935.....	8,299	....	....	96.00		
1931 ..	9,686	....	....	113.00		
1929.....	16,814	....	....	146.00		

Manufacturers: 22, 135, 146, 166, 197, 275, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	70,400 tons	....	549	$164.00[6]	Paints, enamels, putty, ceramics	tech.
1937.....	65,552	34	532	190.00		
1935.....	68,859	6	487	174.00		
1931.....	66,446	....	....	209.00		
1929.....	104,872	....	....	226.00		

Manufacturers: 22, 135, 146, 166, 197, 275, 358.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	28,583 tons	....	862	$124.00[6]	Paints, enamels, putty, ceramics	tech.
1937.....	32,661	....	705	140.00		
1935.....	27,972	....	2,337	124.00		
1931.....	30,922	....	....	124.00		
1929.....	42,159	....	....	162.00		

Manufacturers: 135, 146, 147, 166, 275, 289, 358.

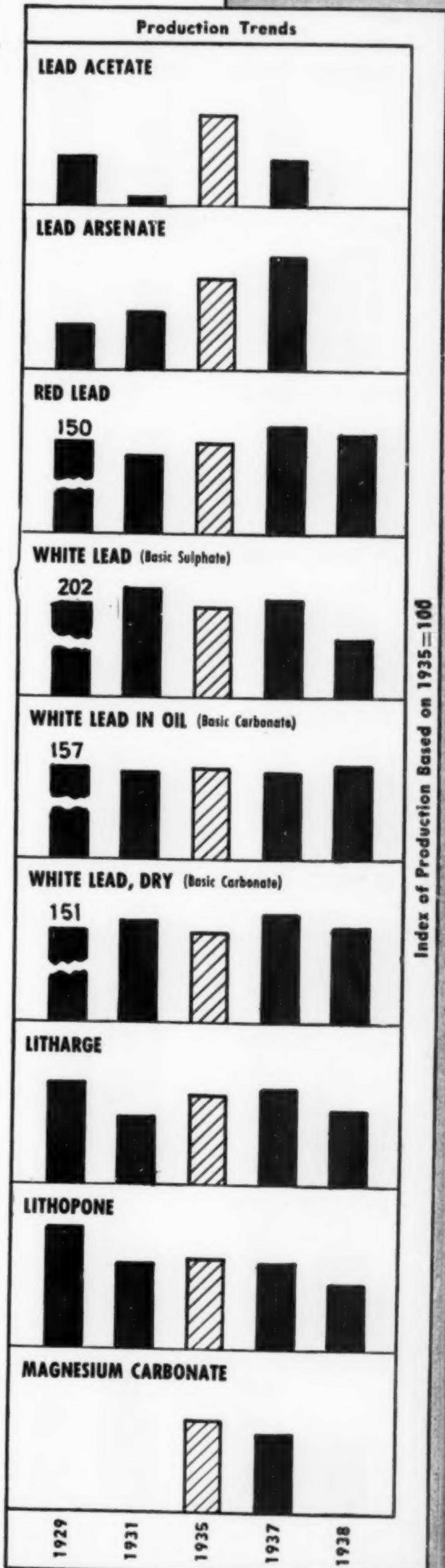
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	68,711 tons	....	1,694	$122.00[6]	Batteries, insecticides, pigments,	tech.
1937.....	83,902	....	1,452	143.00	oil refining, ceramics, varnish,	
1935.....	79,930	....	1,280	104.00	rubber, linoleum	
1931.....	63,890	....	....	109.00		
1929.....	87,916	2	....	157.00		

Manufacturers: 22, 133, 135, 166, 282, 358, 405.

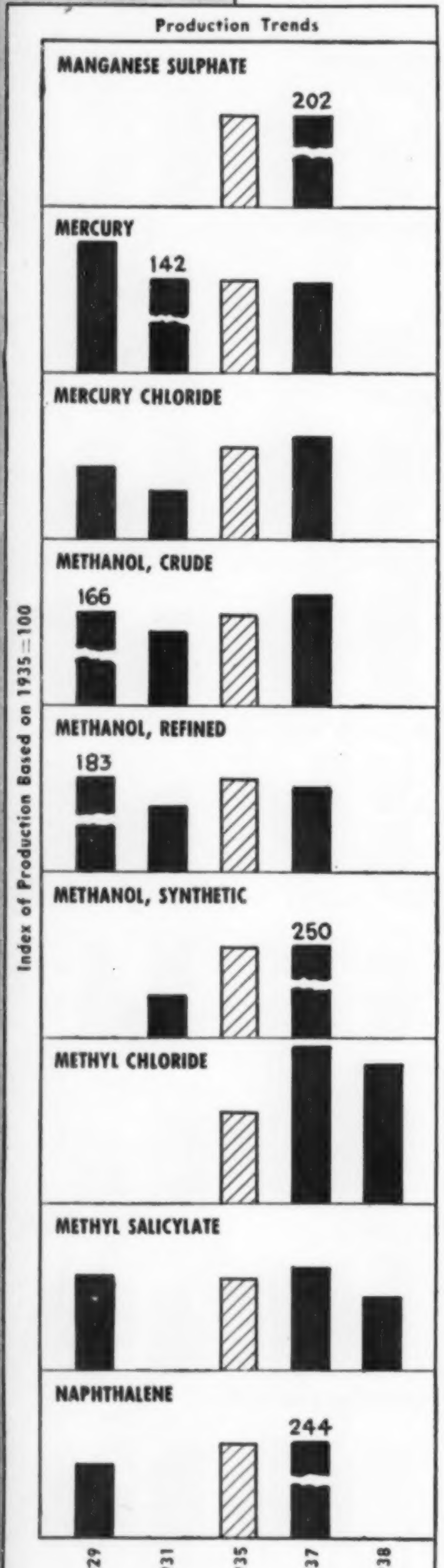
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	125,746 tons	3,932	1,734	$79.00[5]	Paints, enamels, oil cloth, lino-	tech.
1937.....	154,771	5,601	2,671	78.00	leum, textiles, rubber	
1935.....	159,486	4,603	2,372	84.00		
1931.....	151,850	5,677	3,871	86.00		
1929.....	206,315	9,789	4,556	96.00		

Manufacturers: 11, 78, 133, 194, 209, 238, 241, 263, 323.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, ceramics, glass, cos-	
1937.....	6,505 tons	....	....	$121.17[3]	metics, tooth pastes, boiler-scale	tech.
1935	7,301	301	....	120.22	compounds, mineral waters, table	U. S. P.
1931.....	....	285	....	....	salt, rubber	
1929.....	....	259	....	....		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 38, 80, 112 133, 178, 249, 387, 388.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, ceramics, dyes, paper,	tech.
1937.....	12,518,876 lb.	....	....	2.57¢[2]	fertilizer, textiles, driers	C. P.
1935.....	6,211,704	....	....	3.07		
1931.....	....	1,801	....	....		
1929.....	....	22,116	....	....		

Manufacturers: 24, 61, 92, 102, 167, 185, 239, 255, 333, 351, 352, 411.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Cells for chlorine and caustic	tech.
1937.....	16,508 flasks	18,917	454	$90.18[3]	soda production, explosives, mer-	U. S. P.
1935.....	17,518	7,815		71.99	curic salts, pharmaceuticals, min-	
1931.....	29,947	....	....	89.35	ing, thermometers, electrical and	
1929.....	23,682	....	....	122.15	power purposes	

Manufacturers: 38, 48, 238, 249, 317.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Paints, mercury, salts, chemicals,	tech.
1937.....	520,216 lb.	....	....	$1.16[2]	pigment, ceramics, electric bat-	C. P.
1935.....	478,486	....	....	0.90	teries, medicine	U. S. P.
1931.....	285,734	2,121	....	1.14		
1920.....	375,034	2,676	....	1.62		

Manufacturers: 27, 51, 60, 98. 99, 116, 120, 126, 154, 163, 168, 179, 201, 213, 225, 300, 301, 313, 316, 388, 396, 402, 432.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, varnish, enamel, paint	crude
1937.....	6,008,093 gal.	....	....	15.82¢[2]	removers, dyes, denaturant, anti-	ref.
1935.....	5,048,720	....	....	16.21	freeze, textiles	
1931.....	4,283,652	....	....	14.34		
1929.....	8,355,189	....	....	35.18		

Manufacturers: 27, 90, 126, 281.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Lacquers, methylating agent,	ref.
1937.....	3,437,758 gal.	69	....	30¢[2]	solvent for fats, oils, resins, cos-	
1935.....	3,648,180	47	....	31.48	metics, artificial leather	
1931.....	2,737,046	....	....	32.32		
1929.....	6,676,321	538,427	....	58.52		

Manufacturers: 73, 96, 108, 133.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	196,269	....	Chemicals, anti-freeze, varnish,	pure
1937.....	33,374,015 gal.	....	839,156	27.29¢[2]	lacquers, dyes, textiles, solvent	
1935.....	13,359,247	....	618,556	27.03		
1931.....	7,007,332	....	582,925	20.87		
1929.....	....	....	498,481	....		

Manufacturers: 26, 46, 133, 321, 420.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	3,064,227 lb.	....	....	31.37¢[4]	Intermediates, perfume, thermo-	tech.
1937.....	3,389,125	....	....	30.78	meters, refrigerant, solvent	
1935.....	2,083,974	....	....	33.06		
1931.....	....	....	....	....		
1929.....	....	....	....	....		

Manufacturers: 38, 132, 151, 165, 181, 249, 261.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	1,287,481 lb.	....	....	31.86¢[4]	Extracts, foods, disinfectants,	tech.
1937.....	1,677,329	....	....	32.33	soaps, dentifrices	U. S. P.
1935.....	1,543,838	....	....	30.95		
1931.....	....	....	....	....		
1929.....	1,572,187	....	....	34.82		

Manufacturers: 43, 67, 113, 118, 211, 214, 325, 338, 339, 347, 357.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Intermediates, chemicals, dyes,	crude
1937.....	115,979,238 lb.	....	....	.023¢[4]	explosives, insecticides, resins,	C. P.
1935.....	47,653,372	....	....	.017	plastics, tanning, preservatives	U. S. P.
1931.....	....	....	....	....		
1929.....	39,201,046	....	....	....		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 67, 95, 133, 161, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Intermediates, dyes, drugs, perfumes	crude ref.
1937.....	1,159,511 lb.	....	....	51¢[4]		
1935.....	923,270	....	....	53		
1931.....	....	6,313	....	....		
1929.....	122,425	34,486	....	56		

Manufacturers: 133, 161, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Intermediates, dyes, dyeing, photography	tech. ref.
1937.....	3,281,458 lb.	....	....	33¢[4]		
1935.....	2,986,083	....	....	....		
1931.....	....	....	....	....		
1929.....	3,801,144	....	....	24		

Manufacturers: 67, 133, 261, 268, 279.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Intermediates, chemicals, dyes, explosives, cosmetics, polishes, cement, perfume	tech. redist.
1937.....	53,301,541 lb.	....	....	7.21¢[4]		
1935.....	48,170,999	....	....	7.58		
1931.....	....	....	....	....		
1929.....	47,931,925	....	....	8.81		

Manufacturers: 89, 274, 296, 332, 433.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Anesthetic.....................	pure U. S. P.
1937.....	97,768 M. gal.	....	....	11.40[2]		
1935.....	95,861	....	....	9.87		
1931.....	94,607	....	....	9.75		
1929.....	109,812	....	....	10.88		

Manufacturers: 30, 39, 50, 57, 368, 395.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	52,272,923 lb.	....	74,697 gal.	9.25¢[3]	Lubricants, medicine, fly paper, paint, soap, linoleum, printing ink	tech.
1937.....	68,972,693	....	79,196	9.25		
1935.....	46,627,313	....	39,737	9.75		
1931.....	49,912,138	....	70,107	10		
1929.....	76,059,839	....	85,831	12.75		

Manufacturers: 37, 142, 166, 308, 328, 360, 368.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	286,850,169 lb.	363,940,505	4,812,887	3.5¢[3]	Ed. G. E. products, bakeries, soap, cosmetics, ointments, shampoos	crude ref.
1937.....	266,635,868	337,375,696	7,132,860	6.5		
1935.....	252,841,492	120,058,817	11,179,455	4.625		
1931.....	303,434,086	325,174,560	15,306,665	4.125		
1929.....	352,654,322	411,936,213	29,532,396	6.75		

Manufacturers: 14, 101, 114, 166, 312, 320, 369, 403.

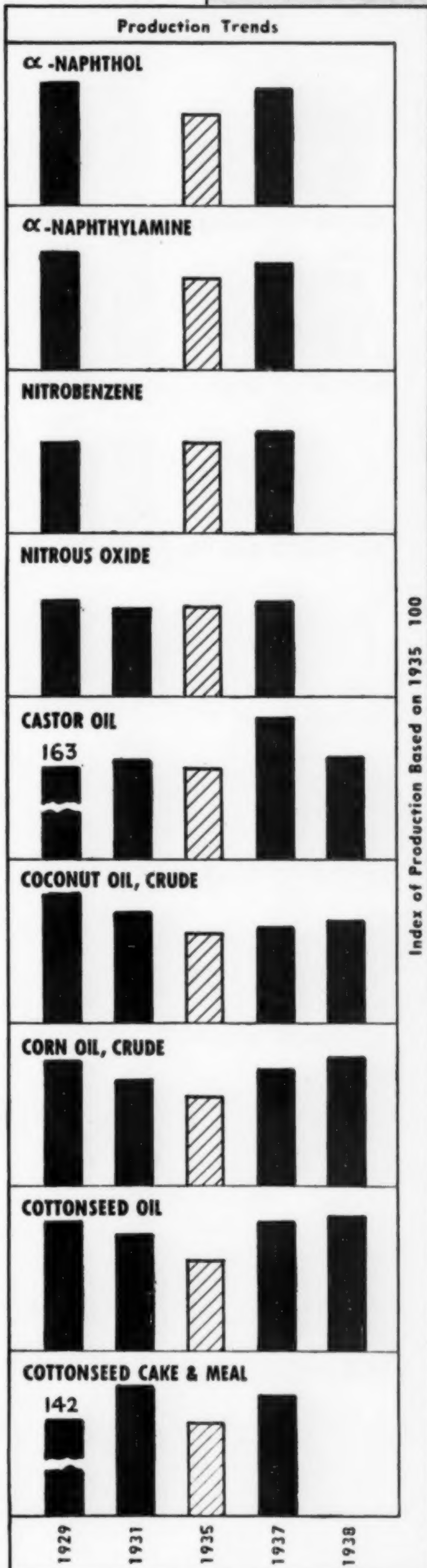
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	136,729,481 lb.	....	....	7.125¢[3]	Food products, salad oils, soap, paints, oil cloth, linoleum, lubricating oils	....
1937.....	127,465,583	....	....	8.5		
1935.....	99,787,789	....	....	9.5		
1931.....	113,746,774	....	....	6.5		
1929.....	133,679,846	....	....	8.5		

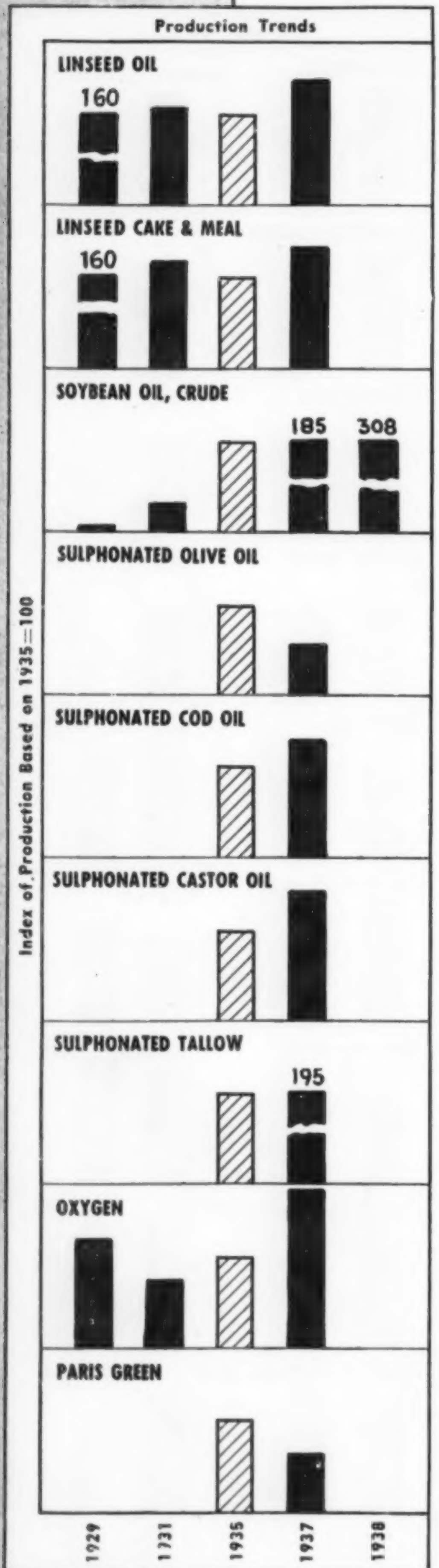
Manufacturers: Hundreds of mills.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	1,677,672,907 lb.	77,500,218	428,146	....	Oleomargarine, salad oils, bakeries, soap, leather, textiles, canning, medicine	crude ref.
1937.....	1,626,215,044	194,008,241	7,250,190	9.11¢[2]		
1935.....	1,184,038,800	166,687,367	3,815,556	8.29		
1931.....	1,441,881,530	1,012	22,577,657	6.32		
1929.....	1,604,131,038	168,121	26,075,021	8.35		

Manufacturers: See above.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	3,295	47,237 tons	....	Cattle food, fertilizer...........	com.
1937.....	2,031,488 tons	97,004	3,625	$34.35[2]		
1935.....	1,614,345	29,872	6,675	33.47		
1931.....	2,164,820	766	157,226	27.08		
1929.....	2,281,576	21,885	211,604	39.76		



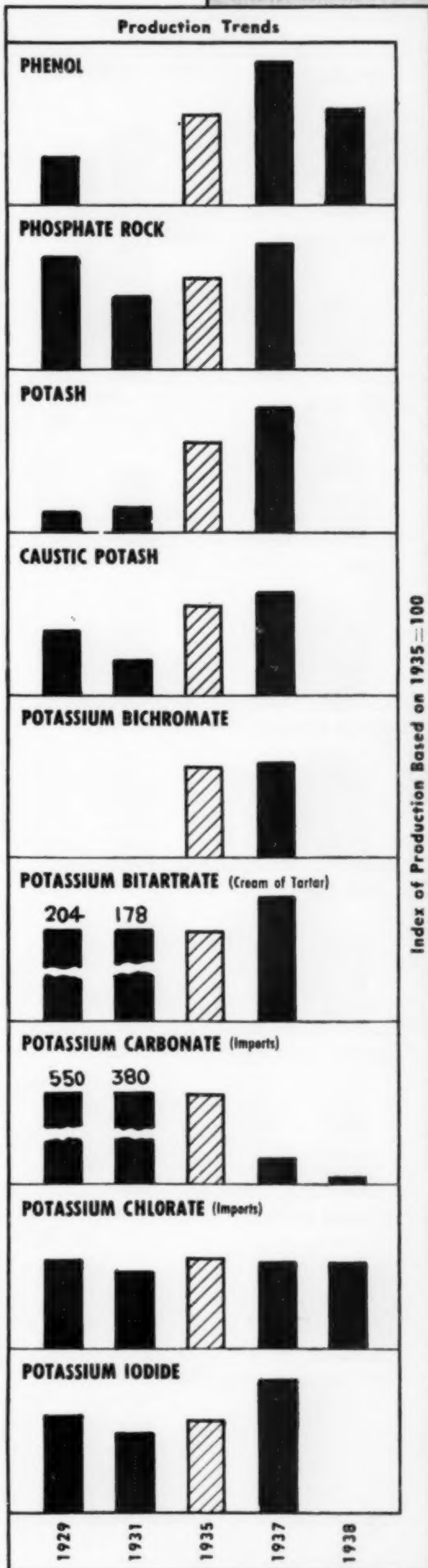


CURRENT DATA OF CHEMICAL RAW MATERIALS

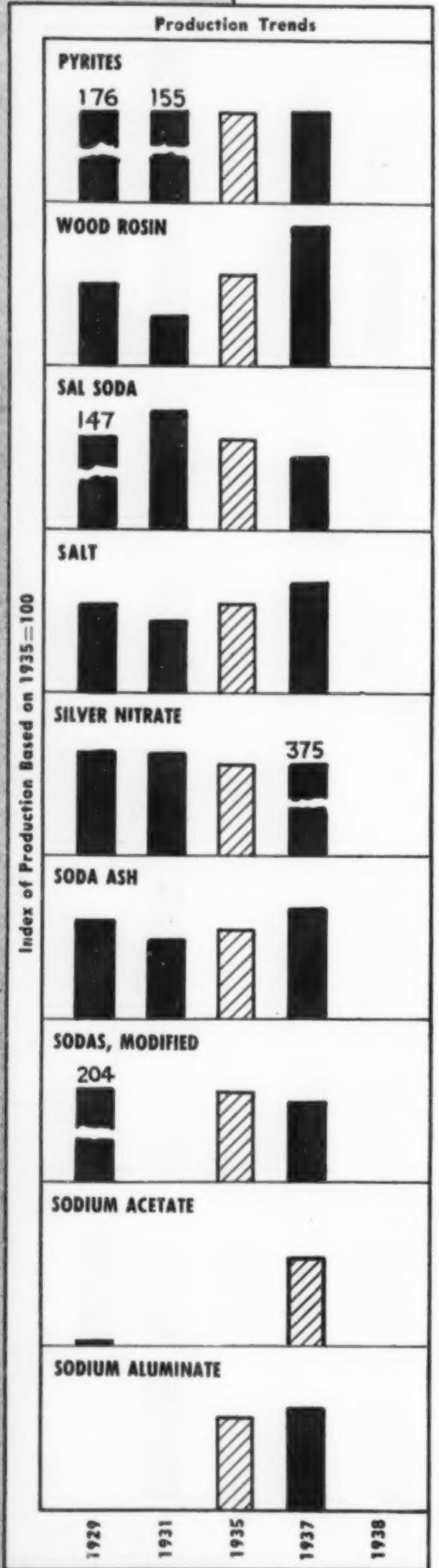
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
Manufacturers: 30, 54, 63, 69, 142, 156, 166, 224, 275, 308, 322, 358, 368.						
1938.....	....	123,214	890,038	....	Paint, varnish, linoleum, oil cloth,	raw
1937.....	665,098,850 lb.	392,729	987,108	9.36¢[2]	printing inks, soap	boiled
1935.....	502,043,424	2,232,451	986,109	8.96		ref.
1931.....	520,735,372	235,492	1,094,261	8.55		
1929.....	803,868,106	9,960,961	2,208,305	9.37		
Manufacturers: 30, 54, 63, 69 142, 156, 166, 234, 275, 308, 322, 358, 368.						
1938.....	....	7,783 tons	204,339 tons	....	Cattle food..................	tech.
1937.....	607,118 tons	12,258	306,737	$36.44[2]		
1935.....	470,760	10,490	207,554	28.44		
1931.....	542,173	9,404	206,382	31.91		
1929.....	752,110	34,642	327,898	48.33		
Manufacturers: 19, 30, 55, 101, 138, 153, 160, 166, 199, 219, 240, 328, 335, 358, 368, 369, 374.						
1938.....	323,342,588 lb.	4,258,115	....	6.5¢[3]	Food products, paint, oil cloth,	crude
1937.....	194,411,398	29,752,024	....	9	linoleum, inks, soap	ref.
1935.....	105,056,204	14,248,574	....	9.5		
1931.....	39,149,653	4,916,253	....	6.75		
1929.....	11,008,743	19,489,129	....	8.5		
Manufacturers: 11, 28, 127, 161, 180, 276, 362, 439,						
1938.....	....	....	....	....	Textiles, leather...............	tech.
1937.....	5,064,192 lb.	....	....	12.53¢[2]		
1935.....	8,108,119	....	....	13.52		
1931.....	....	....	....	....		
1929.....	....	....	....	....		
Manufacturers: 11, 180, 276, 362, 439.						
1938.....	....	....	....	....	Leather, textiles...............	tech.
1937.....	9,666,392 lb.	....	....	6.83¢[2]		
1935.....	7,613,207	....	....	6.45		
1931.....	....	....	....	....		
1929.....	....	....	....	....		
Manufacturers: 11, 124, 127, 161, 180, 275, 276 358, 362, 439.						
1938.....	....	....	....	....	Textiles, leather...............	tech.
1937.....	25,672,661 lb.	....	....	9.67¢[2]		
1935.....	18,389,647	....	....	9.73		
1931.....	....	....	....	....		
1929.....	....	....	....	....		
Manufacturers: 11, 180, 276, 362, 439.						
1938.....	....	....	....	....	Leather......................	tech.
1937.....	17,023,512 lb.	....	....	5.83¢[2]		
1935.....	8,725,241	....	....	6.35		
1931.....	....	....	....	....		
1929.....	....	....	....	....		
Manufacturers: 2, 89, 109, 274, 296, 332, 401.						
1938.....	....	....	....	....	Cutting and welding, anesthesia,	tech.
1937	4,441,391 M. cu. ft.	....	....	$5.87[2]	ozone, explosives, fuel, oxidizing	pure
1935.....	2,683,859	....	....	6.73	oils, medicine	U. S. P.
1931.....	2,050,377	....	....	8.00		
1929.....	3,140,095	....	....	7.46		
Manufacturers: 25, 38, 132, 133, 162, 220, 231, 233, 358.						
1938.....	....	....	....	....	Paints, pigments, wood preserv-	tech.
1937.....	1,834,340 lb.	108,825	....	18.33¢[5]	ative, insecticide, germicide	
1935.....	2,638,210	38,085	....	18.55		
1931.....	....	2,364	....	....		
1929.....	....	1,102	....	....		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
Manufacturers: 43, 67, 118, 132, 214, 261, 338.						
1938.....	44,547,798 lb.	...	...	...	Plastics, intermediates, dyes,	tech.
1937.....	65,689,782	...	...	10.76¢ [4]	paint removers, disinfectants,	C. P.
1935.....	43,418,579	...	...	9.92	explosives, perfumes, medicine	U. S. P.
1931.....	...	...	...	...		
1929.....	24,177,618	...	...	11.28		
Manufacturers: 5, 11, 23, 32, 195, 419.						
1938.....	...	...	1,140,841	...	Superphosphates, phosphates,	variable
1937.....	4,261,416 tons	...	1,052,802	$3.28 [2]	phosphoric acids, fertilizer stock	calcium
1935.....	3,159,328	100	1,104,394	3.60	and poultry food	phosphate
1931.....	2,666,509	13,496	952,305	3.66		content
1929.....	3,787,255	44,899	1,142,746	3.21		
Manufacturers: 16, 292, 326, 407.						
1938.....	...	379,486	75,122	...	Fertilizers, chemicals..........	muriate
1937.....	486,090 tons	767,861	103,031	$19.32 [5]		sulphate,
1935.....	357,974	569,419	75,983	12.27		kainit,
1931.....	133,920	528,764	32,460	23.14		manure
1929.....	107,820	777,909	11,376	29.48		salts
Manufacturers: 170, 194, 286, 361, 429.						
1938.....	...	486	...	...	Soap, potassium compounds,	tech.
1937.....	10,839 tons	1,137	...	$132.62 [2]	matches, bleaching, engraving	liq.
1935.....	9,518	1,713	...	131.33		U. S. P.
1931.....	4,818	4,315	...	120.54		
1929.....	7,191	7,824	...	90.12		
Manufacturers: 129, 265, 278.						
1938.....	...	...	...	...	Tanning, dry colors, chemicals,	tech.
1937.....	4,717,202 lb.	...	...	8.19¢ [2]	matches, pigments, textiles,	U. S. P.
1935.....	4,491,316	...	...	8.00	metallurgy	
1931.....	...	4,814	...	...		
1929.....	...	8,880	...	...		
Manufacturers: 10, 38, 178, 249, 317, 344.						
1938.....	...	36,108	...	...	Baking powder, tartrates, gal-	tech.
1937.....	5,080,455 lb.	40	...	17.39¢ [2]	vanizing, medicine	C. P.
1935.....	3,855,022	12	...	16.65		U. S. P.
1931.....	6,881,444	93,282	...	22.85		
1929.....	7,852,550	181,352	...	24.50		
Manufacturers: 11, 133, 162, 194, 286, 361.						
1938.....	...	583,120 lb.	...	5.75¢ [3]	Chemicals, ceramics, explosives,	tech.
1937.....	...	1,575,727	...	6.75	mineral waters, glass, tanning,	pure
1935.....	...	4,124,635	...	7.	soap, textiles	U. S. P.
1931.....	...	15,166,667	...	5.125		
1929.....	...	22,644,034	...	5.375		
Manufacturers: 298.						
1938.....	...	13,696,491 lb.	...	9.25¢ [3]	Matches, explosives, dyes, dis-	com.
1937.....	...	13,911,061	...	9.	infectant, medicine	pure
1935.....	...	14,317,485	...	9.		C. P.
1931.....	...	12,416,242	...	8.		U. S. P.
1929.....	...	13,956,274	...	7.75		
Manufacturers: 38, 112, 132, 162, 238, 249, 284, 317.						
1938.....	...	...	...	...	Medicine, reagent, photography.	com.
1937.....	612,696 lb.	...	...	97.77¢ [3]		pure
1935.....	433,489	...	...	$1.32		U. S. P
1931.....	380,047	1,305	...	3.40		
1929.....	443,557	1,262	...	3.35		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Year	Production	Imports	Exports	Avg. Value	Uses	Grades
Manufacturers: 23, 162, 260, 264, 310, 349, 357, 387, 418.						
1938		334,234			Manufacture of sulphuric acid	ore
1937	584,166 tons	524,430		$3.04 [5]		conc.
1935	514,192	397,113		3.08		
1931	330,848	352,066		2.95		
1929	333,465	514,336		3.75		
Manufacturers: 180, 283.						
1938			341,177		Paint, varnish, soap, plastics,	com.
1937	799,629 500-lb. bbl.		279,828	$13.01 [2]	paper, sizes, oils and greases,	
1935	520,001		276,406	7.89	polishes, inks	
1931	333,512		153,628	5.71		
1929	478,555		196,888	11.37		
Manufacturers: 11, 94, 129, 133, 162, 361, 426.						
1938					Scouring wool, bottle-washing	tech.
1937	33,064 tons		1,040	$23.25 [2]	compounds, household uses	
1935	39,439		1,143	25.79		
1931	49,836		4,529	26.47		
1929	57,850		6,197	26.33		
Manufacturers: 129, 132, 248, 253, 314, 322, 361, 363, 377, 429.						
1938					Chemicals	brine
1937	4,631,580 tons [11]			40.2¢ [5]		
1935	3,837,613			40.5		
1931	3,300,210			49.3		
1929	3,844,160			50.4		
Manufacturers: 38, 112, 141, 178, 238, 249.						
1938					Photography, medicine, mother	tech.
1937	7,249,421 oz.			31.52¢ [2]	of pearl, silver plating, silver	
1935	5,194,507			36.72	salts, glass	
1931	5,596,998			21.42		
1929	5,646,749			35.70		
Manufacturers: 11, 16, 62, 106, 129, 133, 245, 253, 303, 314, 361, 363.						
1938			51,016		Glass, chemicals, soap, cleaners,	light
1937	3,037,421 tons		54,735	$14.10 [2]	pulp and paper, water softeners,	dense
1935	2,508,859	20	43,525	15.19	petroleum refining, textiles, boiler	
1931	2,275,416	7	29,289	14.91	compounds	
1929	2,682,216	4	38,957	19.10		
Manufacturers: 11, 106, 129, 253, 303, 314, 361, 363.						
1938					Cleansers	various
1937	26,497 tons			$39.66 [2]		mixtures
1935	29,103			39.17		
1931						
1929	59,154		9,596	31.43		
Manufacturers: 38, 133, 154, 162, 249, 261, 285, 388.						
1938					Dyes, intermediates, chemicals,	tech.
1937	6,169,383 lb.			3.95¢ [2]	pharmaceuticals, photography,	pure
1935					preservative, textiles, medicine	C. P.
1931		507,949				U. S. P.
1929	592,253	874,805		5.55		
Manufacturers: 11, 261, 266.						
1938					Textiles, water purification, glass,	tech.
1937	7,238 tons			$60.46 [2]	paper, cleansers, soap	
1935	6,770			61.70		
1931						
1929						

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 133, 250, 421.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Ceramics, glass, glazes	tech.
1937	4,347,866 lb.	....	....	12.74¢[2]		
1935	4,100,543	....	....	10.76		
1931	....	....	....	....		
1929	....	....	....	....		

Manufacturers: 106, 129. 133, 194, 245, 253, 314, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	10,482	....	Baking powder, foods, soft	C. P.
1937	142,161 tons	....	9,635	$25.37[2]	drinks, ceramics, preservative	U. S. P.
1935	136,556	....	6,739	26.79		
1931	127,981	10	9,350	29.15		
1929	140,234	2	9,472	28.97		

Manufacturers: 127, 129, 265, 278.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	2,419 tons	....	Tanning, dry colors, textiles,	tech.
1937	48,697 tons	....	3,160	$121.68[2]	pigments, engraving, bleaching,	C. P.
1935	42,325	....	3,650	112.53	chrome alum	
1931	24,745	63 lb.	2,204	127.80		
1929	39,301	350	2,928	130.72		

Manufacturers: 16, 303, 305, 426.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	77,519 tons	....	Ceramics, soap, glazes, chemicals,	tech.
1937	126,166 tons	724 lb.	153,772	$27.32[2]	leather, textiles, preservative,	C. P.
1935	106,131	748	114,447	34.80	medicine	U. S. P.
1931	80,004	1,516	86,938	30.40		
1929	92,250	7,504	79,881	35.55		

Manufacturers: 133, 298.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	5,156,164 lb.	....	6.25¢[3]	Weed killer, matches, explosives,	tech.
1937	....	7,069,842	....	6.25	leather, textiles, medicine	C. P.
1935	....	2,533,104	....	6.25		U. S. P.
1931	....	3,495,570	....	5.75		
1929	....	7,738,862	....	7.00		

Manufacturers: 11, 133, 162

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	26,387,452 lb.	1,136,161	14.5¢[3]	Metal extraction, metallurgy,	com.
1937	....	35,295,058	888,970	16.25	electroplating, hydrocyanic acid,	pure
1935	....	26,539,660	1,005,518	15.5	insecticide	C. P.
1931	....	18,695,132	1,121,173	15.5		
1929	....	137,343	1,815,861	17.00		

Manufacturers: 11, 59, 249.

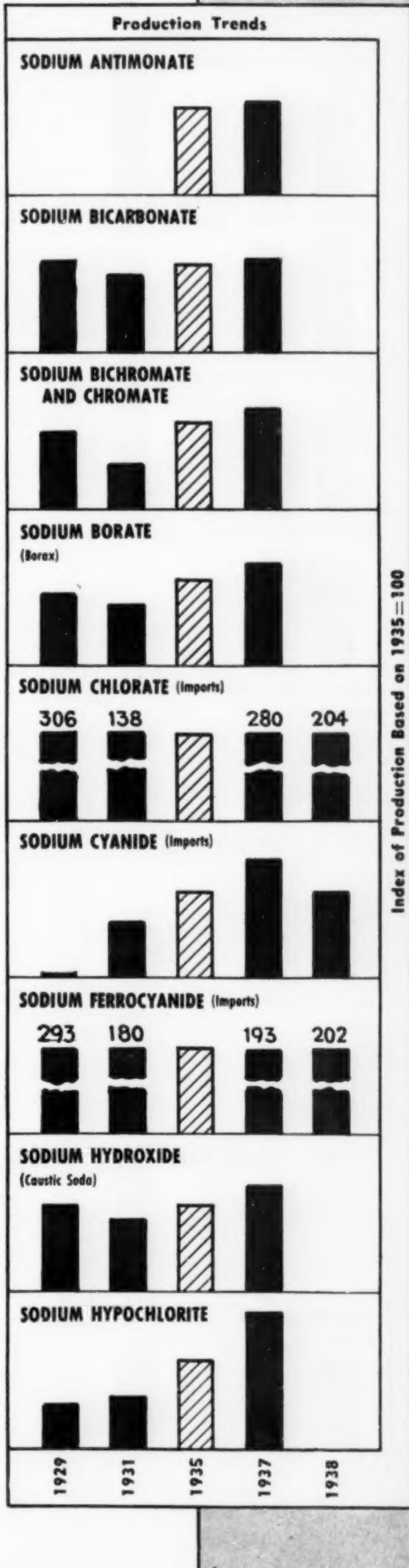
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	1,343,511 lb.	....	9.75¢[3]	Dry colors, photography, tan-	tech.
1937	....	1,283,329	....	10.00	ning, metallurgy, window shades,	
1935	....	663,393	....	11.5	blueprints	
1931	....	1,185,467	....	11.5		
1929	....	1,939,502	....	11.5		

Manufacturers: 46, 106, 129, 132, 133, 143, 170, 184, 194, 245, 253, 261, 286, 288, 314, 361, 363, 377, 429.

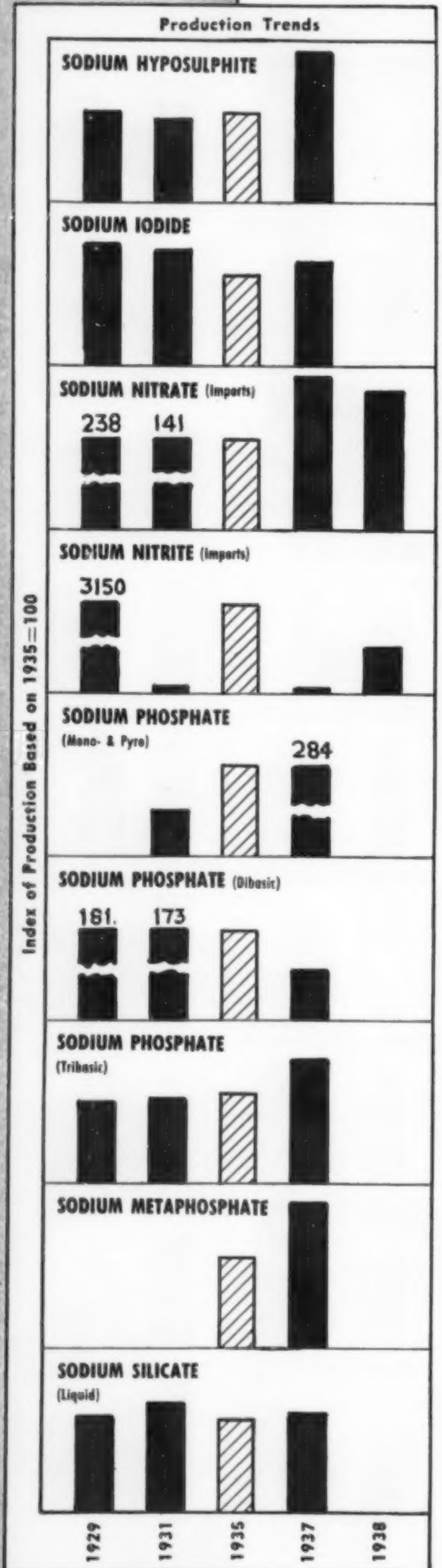
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	100,024	....	Soap, chemicals, petroleum re-	com.
1937	961,591 tons	....	102,267	$35.71[2]	fining, rayon, film, lye, textiles,	C. P.
1935	759,381	147	69,569	39.06	rubber, pulp and paper	U. S. P.
1931	658,889	70	65,594	41.89		
1929	761,792	86	58,695	49.81		

Manufacturers: 46, 180, 261, 314, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	....	....	....	....	Pulp, paper, textiles, water puri-	tech.
1937	75,073 tons	....	....	$83.58[2]	fication, chemicals, disinfectant	
1935	50,807	....	....	84.73		
1931	32,323	....	....	79.62		
1929	26,772	....	....	75.30		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 90, 133, 162, 222, 343, 345, 439.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	...	...	Tanning, photography, pulp and	com.
1937.....	39,486 tons	...	...	$35.75[2]	paper, disinfectant, textiles, min-	pure
1935.....	24,477	...	...	43.07	ing	C. P.
1931.....	23,512	49	...	41.22		U. S. P
1929.....	25,020	13	...	56.23		

Manufacturers: 32, 162, 238, 249, 284, 317.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	...	...	Medicine, chemicals, photog-	tech.
1937.....	42,062 lb.	...	...	1.94¢[2]	raphy	C. P.
1935.....	38,024	...	...	2.16		U. S. P.
1931.....	47,658	...	...	4.08		
1929.....	49,796	...	...	4.32		

Manufacturers: 36.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	577,130 tons	...	1.45¢[3]	Fertilizers, chemicals, glass, pyro-	crude
1937.....	...	628,792	...	1.40	technics, curing meats, medicine	ref.
1935.....	...	390,795	...	1.25		C. P.
1931.....	...	550,613	...	1.98		
1929.....	...	930,458	...	2.125		

Manufacturers: 133, 361.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	59,918 lb.	...	6.75¢[3]	Dyes, chemicals, photography,	com.
1937.....	...	1,470	...	7.125	meat packing	pure
1935.....	...	9,892	...	7.25		C. P.
1931.....	...	2,029	...	7.25		U. S. P.
1929.....	...	312,260	...	7.5		

Manufacturers: 11, 133, 162, 261, 416, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	...	...	Baking powder, medicine......	pure
1937.....	12,841 tons	...	...	$135.12[3]		C. P.
1935.....	4,517	...	...	184.35		U. S. P.
1931.....	2,111	...	...	238.14		
1929.....	...	...	...	...		

Manufacturers: 5, 11, 133, 162, 261, 416, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	...	...	Textiles, soap chemicals, fire-	pure
1937.....	22,330 tons	...	...	$36.47[3]	proofing, tanning, glazes	U. S. P.
1935.....	35,444	...	...	37.75		
1931.....	61,238	...	...	47.15		
1929.....	64,134	...	...	61.68		

Manufacturers: 5, 11, 56, 133, 162, 195, 235, 261, 416, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	3,818	...	Soap, water softeners, boiler com-	com.
1937.....	117,402 tons	...	2,934	36.07[3]	pounds, laundries, tanning, tex-	pure
1935.....	87,100	...	3,556	44.33	tiles, medicine	C. P.
1931.....	82,954	699	3,065	56.35		
1929.....	82,045	8,820	...	61.05		

Manufacturers: 5, 11, 162, 416, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	...	...	Cleaning compounds, soap,	com.
1937.....	7,748 tons	...	...	$122.10[2]	textiles	pure
1935.....	5,147	...	...	100.97		C. P.
1931.....	...	...	...	...		
1929.....	...	...	...	...		

Manufacturers: 8, 129, 133, 162, 231, 314, 319.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	...	...	5,049	...	Soap, adhesives, plywood, tex-	crude
1937.....	600,979 tons	...	7,797	$11.13[2]	tiles, paperboard, sealing cartons,	pure
1935.....	577,587	100	7,879	11.44	cements, concrete, egg preserva-	C. P.
1931.....	664,452	15	29,289	11.29	tive	
1929.....	590,277	157	33,367	12.16		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers:

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Soap, adhesives, plywood, textiles, paperboard, sealing cartons, cements, concrete, egg preservative	tech. pure C. P.
1937.....	40,473 tons	....	....	$38.75[2]		
1935.....	30,536	....	....	34.92		
1931.....	....	....	....	....		
1929.....	....	....	....	....		

Manufacturers: 5, 38, 44, 56, 124, 133, 178, 208, 248.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Laundry, glass, ceramics, insecticides, medicine	tech. C. P.
1937.....	5,601 tons	....	....	$104.04[2]		
1935.....	2,628	2,056	....	77.12		
1931.....	1,357	1,586	66	84.87		
1929.....	2,278	2,230	....	100.13		

Manufacturers: 11, 133, 162, 261, 278, 343.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	5,788	....	....	Chemicals, glass, dyeing, freezing mixtures, medicine	pure C. P. U. S. P.
1937.....	21,797 tons	13,668	....	$14.33[2]		
1935.....	23,609	5,168	....	19.39		
1931.....	7,609	....	....	22.31		
1929.....	....	....	....	....		

Manufacturers: 11, 133, 162, 261, 278, 302, 343, 416.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	127,169	....	....	Pulp, glass, dyes, chemicals, ceramics, textiles	com.
1937.....	269,177 tons	196,586	....	$9.81[2]		
1935.....	192,384	98,553	....	10.97		
1931.....	119,399	72,741	....	15.48		
1929.....	206,612	91,633	....	11.84		

Manufacturers: 11, 56, 133, 141, 162, 222, 238, 249, 261, 390, 439.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Textiles, dyes, chemicals, paper, ultramarine, tanning, medicine	tech. C. P. U. S. P.
1937.....	31,934 tons	....	....	$15.36[2]		
1935.....	39,961	492	....	13.57		
1931.....	48,899	825	....	17.33		
1929.....	61,953	1,037	....	17.95		

Manufacturers: 42, 90, 132, 133, 162, 231, 238, 240 261, 282, 343, 429.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Leather, chemicals, intermediates, rayon, paper, mining, photography	tech.
1937.....	27,266 tons	....	....	$56.09[2]		
1935.....	24,884	1,233	....	55.86		
1931.....	23,268	1,292	344	44.39		
1929.....	33,032	4,983	....	42.58		

Manufacturers: 133, 162, 235, 249, 261.

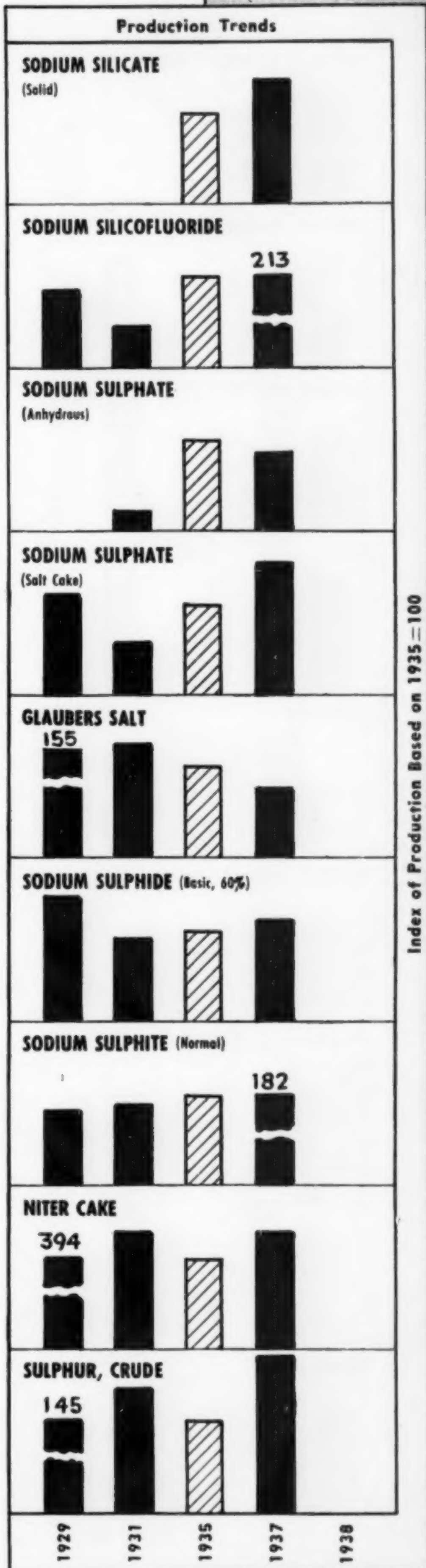
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Chemicals, dyes, cellulose, textiles, paper, preservative, glass, medicine	tech. C. P. U. S. P.
1937.....	12,491 tons	....	....	$62.60[2]		
1935.....	6,840	455	....	69.30		
1931.....	6,437	375	....	88.38		
1929.....	5,970	....	....	77.40		

Manufacturers: 11, 29, 67, 128, 133, 141, 162, 180, 261, 279, 314, 343, 387, 390.

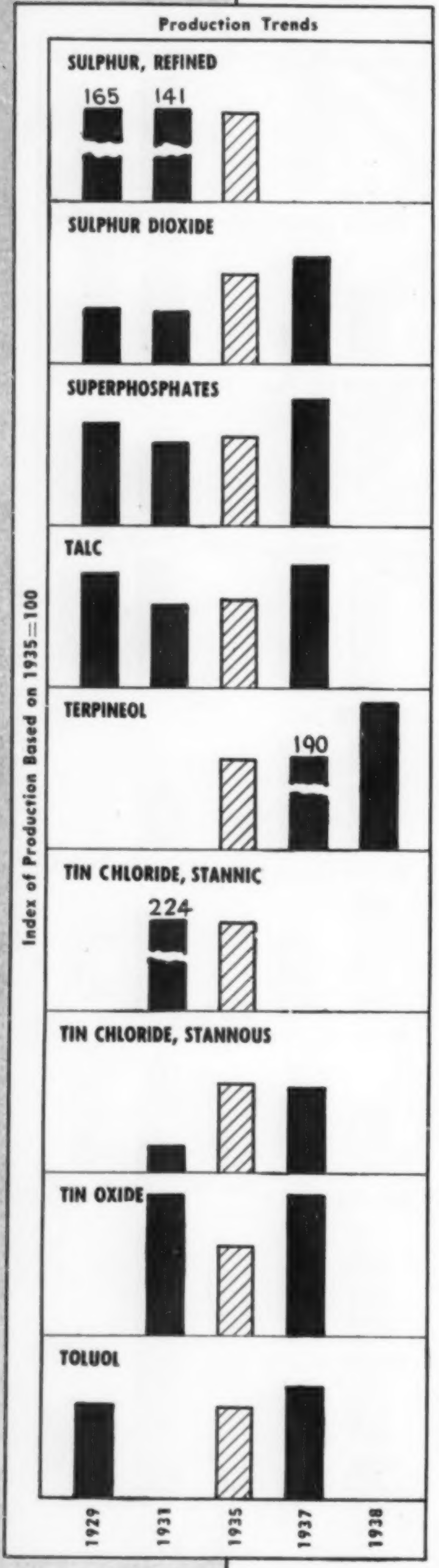
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Glass, chemicals, paper, metallurgy	tech. C. P.
1937.....	36,086 tons	....	....	$22.60[2]		
1935.....	28,252	....	....	18.28		
1931.....	35,680	....	13,352	18.39		
1929.....	111,522	11	....	12.37		

Manufacturers: 134, 157, 204, 379, 391, 410, 417.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	$16.00[2]	Sulphuric acid, chemicals, pulp and paper, black powder, dyes, insecticides, rubber, foods, medicine	crude
1937.....	2,741,970 long tons	308	675,000	18.00		
1935.....	1,632,590	1,763	402,383	18.00		
1931.....	2,128,930	....	407,586	18.00		
1929.....	2,362,389	1,163	855,183	18.00		



CURRENT DATA OF CHEMICAL RAW MATERIALS



Manufacturers: 11, 91, 133, 377.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	28,462,955 lb.	...	Medicine, disinfectants, cattle feeds	ref.
1937	...	...	29,668,810	...		
1935	47,504 tons	...	24,452,269	$34.73[2]		
1931	66,914	...	27,197,699	34.90		
1929	78,119	...	38,558,995	39.25		

Manufacturers: 26, 132, 170, 244, 420.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	...	...	Chemicals, intermediates, bleaching agent, preservative, disinfectant, fire extinguisher	com.
1937	28,717,125 lb.	...	...	5.13¢[2]		
1935	24,628,183	...	...	4.75		
1931	16,104,534	...	...	5.21		
1929	17 600,936	...	...	5.53		

Manufacturers: 5, 44, 124, 195, 346, 387.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	90,237	...	Fertilizers	com.
1937	5,003,776 tons	...	78,949	$10.44[2]		
1935	3,674,356	...	54,966	9.33		
1931	3,492,771	...	81,754	10.51		
1929	4,133,134	...	85,118	11.21		

Manufacturers: 34, 58, 75, 79, 85, 100, 103, 139, 148, 175, 196, 230, 266, 306, 353, 359, 366, 384, 393, 413, 414, 428.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	22,127	6,355	...	Paint, paper, ceramics, rubber, roofing, toilet preparations, foundry facings	crude
1937	229,999 tons	26,876	7,927	$11.14[5]		sawed
1935	172,716	23,897	5,814	10.70		ground
1931	163,752	23,548	...	11.31		
1929	219,783	31,247	...	11.96		

Manufacturers: 133, 165, 180.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	638,797 lb.	...	...	19.99¢[4]	Perfumes, soap	tech.
1937	781,152	...	...	20.16		
1935	412,095	...	...	24.93		
1931	...	...	...	...		
1929	...	...	...	...		

Manufacturers: 133, 162, 238, 250, 251, 422, 430.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	...	...	Textiles, calomel, dyes, color lakes, ceramics, sugar, medicine	tech.
1937	...	...	...	...		C. P.
1935	15,640,763 lb.	...	...	25.42¢[2]		
1931	34,871,533	...	...	16.47		
1929	...	...	...	...		

Manufacturers: 133, 162, 238, 250, 251, 422, 430.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	...	...	Intermediates, chemicals, dyes, textiles, sugar	tech.
1937	460,841 lb.	...	...	39.17¢[2]		C. P.
1935	477,229	...	...	36.63		
1931	193,347	...	...	23.15		
1929	...	...	...	...		

Manufacturers: 17, 47, 133, 178, 248, 249, 250.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	...	...	Tin salts, textiles, ceramics, cosmetics, polishing powders, glass	com.
1937	3,323,715 lb.	...	...	51.37¢[2]		pure
1935	2,245,462	...	...	51.94		C. P.
1931	3,330,156	...	...	27.38		
1929	...	...	...	...		

Manufacturers: 43, 67, 113, 129, 133, 193, 207, 214, 280, 291, 338.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938	...	...	...	...	Dyes, perfumes, tolidines, explosives	pure
1937	20,896,724 gal.	...	...	26.5¢[1]		dist.
1935	17,776,551	...	...	27.9		com.
1931	...	...	...	...		
1929	18,343,295	...	...	33.9		

CURRENT DATA OF CHEMICAL RAW MATERIALS

Manufacturers: 67, 95, 133, 268.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	689,231 lb	....	....	....	Dyes, dyeing and printing.....	tech.
1937.....	1,142,040	....	....	65.08¢[4]		
1935.....	974,866	....	....	62.28		
1931.....	....	....	....	....		
1929.....	911,351	....	....	67.03		

Manufacturers: 180, 283.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	1,884,167	....	Paint, varnish, chemicals, polishes, oils, greases	com.
1937.....	8,723,503 gal.	....	2,059,760	25.8¢[2]		
1935.....	4,611,641	....	945,009	40.2		
1931.....	3,150,490	....	691,751	32.7		
1929.....	4,619,253	....	880,538	37.1		

Manufacturers: 158, 165, 247, 249, 261, 350.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	465,077 lb	....	....	$2.22[4]	Flavors, perfumes, pharmaceuticals	tech. U. S. P.
1937.....	348,461	....	....	3.33		
1935.....	236,896	....	....	2.89		
1931.....	171,669	3,593	....	4.52		
1929.....	317,355	....	....	5.86		

Manufacturers: 178, 183

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Ceramics, glazes..............	com.
1937.....	110,879,218 lb.	....	....	6.16¢[2]		
1935.....	73,397,433	....	....	5.99		
1931.....	42,823,773	....	....	8.05		
1929.....	....	....	....	....		

Manufacturers: 17, 47, 188, 252, 277, 282.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	2,253	....	Intermediates, dyes, chemicals, dyeing and printing, sherardizing	dist. atomized
1937.....	15,242 tons	....	2,145	$169.77[3]		
1935.....	12,453	....	1,613	126.41		
1931.....	10,611	....	1,400	108.20		
1929.....	11,050	....	1,256	168.75		

Manufacturers: 22, 135, 166, 197, 282, 349.

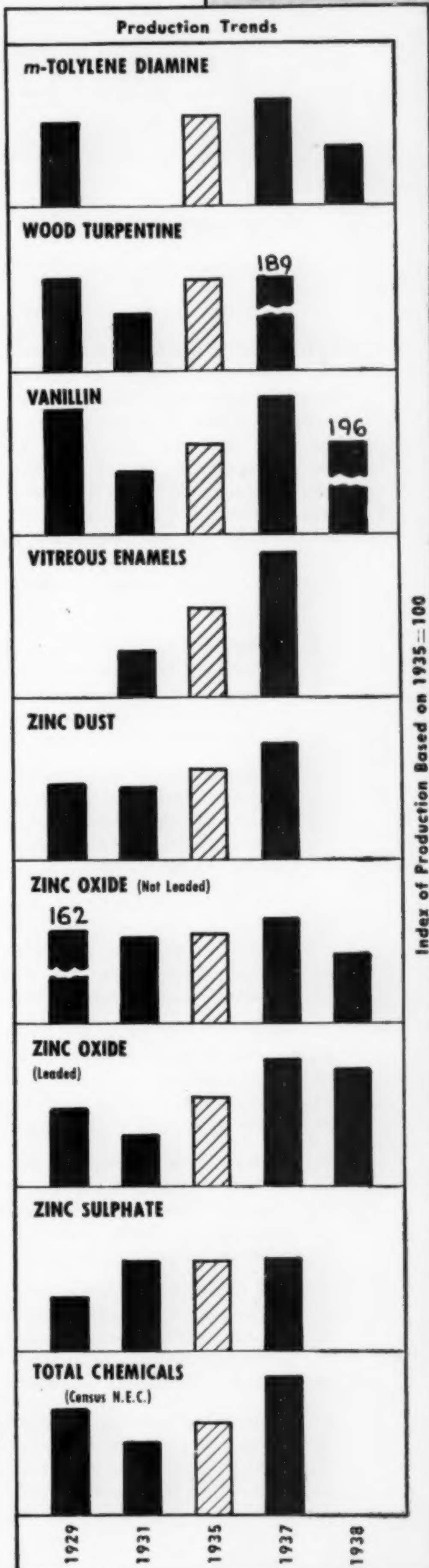
Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	79,129 tons	645	1,163	$117.00[5]	Rubber, paint, varnish, linoleum, oilcloth, ceramics, textiles, ointments	tech. C. P.
1937.....	114,652	775	2,453	103.00		
1935.....	99,697	1,941	1,140	103.00		
1931.....	95,700	1,457	5,135	125.00		
1929.....	160,611	1,378	17,638	128.00		

Manufacturers: 22, 135, 166, 197, 282, 349.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	38,216 tons	....	....	$107.00[5]	Paint, rubber, linoleum, ceramics	tech.
1937.....	40,343	....	....	104.00		
1935.....	29,976	....	....	93.00		
1931.....	18,577	....	....	115.00		
1929.....	27,149	....	....	119.00		

Manufacturers: 133, 178, 249, 349, 358, 387, 420.

Year	Production	Imports	Exports	Avg. Value	Uses	Grades
1938.....	....	....	....	....	Rayon, insecticides, electrogalvanizing, glue, paint, varnish, textiles, medicine	tech. C. P. U. S. P.
1937.....	37,888,157 lb.	1,186,000	....	2.99¢[2]		
1935.....	37,465,565	270,000	....	1.92		
1931.....	37,392,441	116,320	....	1.87		
1929.....	24,903,841	1,818,662	....	2.80		



FOOTNOTES

[1] Figure for 1938 represents sales, for other years, production. [2] Value reported to Bureau of the Census. [3] Quoted prices. [4] Value reported to U. S. Tariff Commission. [5] Value reported to U. S. Bureau of Mines. [6] Imports of all grades. [7] Exports of all grades. [8] Does not include production in paper industry. [9] Basis 100 per cent. [10] Basis 50 per cent H_3PO_4 [11] Basis 50 deg. Be. [12] Production all grades. [13] Basis 100 volume. [14] Data for brine only.

Average value is based on unit reported for production.

CHEMICAL MANUFACTURERS

As a part of the data on more than 200 major chemical commodities in the preceding section, we list the important manufacturers of those commodities

TO ROUND OUT this issue of "Facts and Figures of American Chemical Industry" *Chem. & Met.* has compiled a list of manufacturers of the more important chemicals. The list is composed entirely of companies which actually make these chemical commodities either for their own consumption or for sale and does not include jobbers, wholesalers, retailers or manufacturers' agents.

This table is intended to supplement the data presented on the foregoing pages. The numbers preceding the names of companies are the reference numbers used to relate the companies in this section to their chemical products in the preceding section. With one or two unavoidable exceptions, the companies are listed here in alphabetical order.

Several sources of information have been consulted in the preparation of this list; however, two predominated. The first was a questionnaire sent to some 600 companies requesting information about their products. The second was the personal experience of *Chem. & Met.'s* staff of editors. Much painstaking effort has been expended to obtain the utmost accuracy. For that reason comments and criticisms will be welcomed by the editors.

1. Acticarbone Corp., New York, N. Y.
2. Air Reduction Co., New York, N. Y.
3. Allegheny Chemical Co., Reading, Pa.
4. Allied Chemical & Dye Corp., New York, N. Y.
5. American Agricultural Chemical Co., New York, N. Y.
6. American Aniline Products, Inc., New York, N. Y.
7. American Carbonic Co., Harrison, N. J.
8. American Chemical Paint Co., Ambler, Pa.
9. American Commercial Alcohol Corp., New York, N. Y.
10. American Cream of Tartar Co., San Francisco, Cal.
11. American Cyanamid & Chemical Corp., New York, N. Y.
12. American Dry Ice Corp., New York, N. Y.
13. American Dyewood Co., New York, N. Y.
14. American Maize Products Co., New York, N. Y.
15. American Norit Co., Jacksonville, Fla.
16. American Potash & Chemical Corp., New York, N. Y.
17. American Smelting & Refining Co., New York, N. Y.
18. American Solvents & Chemical Co., Agnew, Calif.
19. American Soya Products Corp., Evansville, Ind.
20. American Steel & Wire Co., New York, N. Y.
21. American Tar & Chemical Co., Duluth, Minn.
22. American Zinc, Lead & Smelting Co., St. Louis, Mo.
23. Anaconda Copper Mining Co., Anaconda, Mont.
24. Anglo-American Mining Corp., Los Angeles, Calif.
25. Ansbacher Siegle Corp., Rosebank, Staten Island, N. Y.
26. Ansul Chemical Co., Marinette, Wis.
27. Antrim Iron Co., Grand Rapids, Mich.
28. Apex Chemical Co., Inc., New York, N. Y.
29. Apothecaries Hall Co., Waterbury, Conn.
30. Archer-Daniels-Midland Co., Minneapolis, Minn.
31. Arkansas Bauxite Corp., Bauxite, Ark.
32. Armour & Co., Chicago, Ill.
33. Arnold Hoffman & Co., Inc., Providence, R. I.
34. Asbestos-Talc Products, Burlington, Wash.
35. Atlas Powder Co., Wilmington, Del.
36. Atmospheric Nitrogen Corp., Hopewell, Va.
37. Franklin Baker Co., Hoboken, N. J.
38. J. T. Baker Chemical Co., Phillipsburg, N. J.
39. Baker Castor Oil Co., New York, N. Y.
40. Barium & Chemicals, Inc., Willoughby, Ohio
41. Barium Products, Ltd., New York, N. Y.
42. Barium Reduction Corp., So. Charleston, W. Va.
43. Barrett Co., New York, N. Y.
44. Baugh and Sons Co., Philadelphia, Pa.
45. Bay Chemical Co., New Orleans, La.
46. Belle Alkali Co., Belle, W. Va.
47. Belmont Smelting & Refining Works, Brooklyn, N. Y.
48. F. W. Berk & Co., Wood-Ridge, N. J.
49. J. E. Berkheimer Mfg. Co., Portland, Ore.
50. Berkshire Chemical Co., Bridgeport, Conn.
51. Thomas Berry Chemical Co., Manistique, Mich.
52. Better Blacks, Pampa, Texas
53. Binney & Smith, New York, N. Y.
54. Bisbie Linseed Co., Philadelphia, Pa.
55. Blariton Companies, St. Louis, Mo.
56. Blockson Chemical Co., Joliet, Ill.
57. Blue Point Oil Co., Blue Point, Long Island, N. Y.
58. Blue Star Mines Ltd., Los Angeles, Calif.
59. Henry Bower Chemical Mfg. Co., Philadelphia, Pa.
60. Bradford Wood Products Co., Marvindale, Pa.
61. Bradley Mining Co., San Francisco, Calif.
62. Brown Company, Portland, Me.
63. Brown Linseed Corp., Port Richmond, N. Y.
64. Buffalo Electro-Chemical Co., Buffalo, N. Y.
65. W. J. Bush & Co. Inc., New York, N. Y.
66. Godfrey L. Cabot, Inc., Boston, Mass.
67. Calco Chemical Co., Inc., Bound Brook, N. J.
68. California Carbonic Co., Los Angeles, Calif.
69. California Flaxseed Products Co., Los Angeles, Calif.
70. California Fruit Growers Exchange, Ontario, Calif.

MANUFACTURERS OF CHEMICALS AND RELATED PRODUCTS

71. California Milk Products Co., Gustine, Calif.
72. California Spray Chemical Corp., Richmond, Calif.
73. Carbide & Carbon Chemicals Corp., New York, N. Y.
74. Carbo Chemical Co., Salt Lake City, Utah
75. Carbola Chemical Co., Natural Bridge, N. Y.
76. Carbonic Mfg. Co., New York, N. Y.
77. Carbo-Oxygen Co., Pittsburgh, Pa.
78. Philip Carey Co., Cincinnati, Ohio
79. Carolina Talc Co., Murphy, N. C.
80. Carus Chemical Co., La Salle, Ill.
81. Casein Company of America, New York, N. Y.
82. Celanese Corporation of America, New York, N. Y.
83. Celina Stearic Acid Co., Celina, Ohio
84. Century Stearic Acid Candle Works, New York, N. Y.
85. Chamberlain Co., Los Angeles, Calif.
86. Champion Paper & Fibre Co., Canton, N. C.
87. Charcoal & Industrial Carbons, Los Angeles, Calif.
88. C. P. Chemical Solvents, Inc., New York, N. Y.
89. Cheney Chemical Co., Cleveland, Ohio
90. Chicago Copper & Chemical Co., Blue Island, Ill.
91. Chipman Chemical Co., Inc., Bound Brook, N. J.
92. Chisos Mining Co., Portland, Me.
93. H. C. Christians Co., Johnsons Creek, Wis.
94. Church & Dwight Co., Inc., New York, N. Y.
95. Cincinnati Chemical Works, Inc., Cincinnati, Ohio
96. Cities Service Oil Co., Bartlesville, Okla.
97. Citro Chemical Co., Maywood, N. J.
98. Clawson Chemical Co., Halton, Pa.
99. Cliffs Dow Chemical Co., Marquette, Mich.
100. Clinchfield Sand & Feldspar Co., Murphy, N. C.
101. Clinton Co., Clinton, Iowa
102. Cloverdale Mining Co., Cloverdale, Calif.
103. Cohutta Talc Co., Dalton, Ga.
104. Colgate-Palmolive-Peet Co., Jersey City, N. J.
105. Collway Colors, Inc., Paterson, N. J.
106. Columbia Alkali Corp., New York, N. Y.
107. Columbian Carbon Co., New York, N. Y.
108. Commercial Solvents Corp., New York, N. Y.
109. Compressed Industrial Gases, Inc., Chicago, Ill.
110. Consolidated Chemical Industries, San Francisco, Calif.
111. Continental Carbon Co., New York, N. Y.
112. Chas. Cooper & Co., New York, N. Y.
113. Coopers Creek Chemical Corp., W. Conshohocken, Pa.
114. Corn Products Refining Co., New York, N. Y.
115. Crescent Carbon Co., Point Pleasant, W. Va.
116. Crossett Chemical Co., Crossett, Ark.
117. Crouch Mining Co., Niagara Falls, N. Y.
118. Crown Tar Works, Denver, Colo.
119. Crystal Carbonic Laboratory, Atlanta, Ga.
120. Custer City Chemical Co., Custer City, Pa.
121. Dairymen's League Co-Op Assn., Inc., New York, N. Y.
122. Darco Corp., Wilmington, Del.
123. Darling & Co., Chicago, Ill.
124. Davison Chemical Corp., Baltimore, Md.
125. Deepwater Chemical Co., Compton, Calif.
126. Delta Chemical & Iron Co., Wells, Mich.
127. Martin Dennis Co., Newark, N. J.
128. Detroit Chemical Works, Detroit, Mich.
129. Diamond Alkali Co., Pittsburgh, Pa.
130. J. Q. Dickenson & Co., Malden, W. Va.
131. Dixie Bauxite Co., Sweet Home, Ark.
132. Dow Chemical Co., Midland, Mich.
133. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
134. Duval Texas Sulphur Co., Houston, Texas.
135. Eagle-Picher Lead Co., Cincinnati, Ohio
136. J. S. and W. R. Eakins Inc., Brooklyn, N. Y.
137. Benjamin Easterlin, Americus, Ga.
138. Eastern Cotton Oil Co., Elizabeth City, N. J.
139. Eastern Magnesia Talc Co., Johnson, Vt.
140. Eastern Tar Products Corp., Baltimore, Md.
141. Eastman Kodak Co., Rochester, N. Y.
142. El Dorado Oil Works, San Francisco, Calif.
143. Electro Bleaching Gas Co., New York, N. Y.
144. Emery Industries, Inc., Cincinnati, Ohio
145. Ethyl Dow Chemical Co., Wilmington, N. C.
146. Euston Lead Co., Scranton, Pa.
147. Evans Lead Corp., New York, N. Y.
148. W. R. Fawcett, Los Angeles, Calif.
149. Fels & Co., Philadelphia, Pa.
150. Felton Chemical Co. Inc., Brooklyn, N. Y.
151. Florasynth Laboratories, Inc., New York, N. Y.
152. Foote Mineral Co., Inc., Philadelphia, Pa.
153. Ford Motor Co., Iron Mountain, Mich.
154. Forest Products Chemical Co., Memphis, Tenn.
155. Franco-American Chemical Works, Carlstadt, N. J.
156. Fredonia Linseed Oil Works, Fredonia, Kan.
157. Freeport-Sulphur Co., New York, N. Y.
158. Fries Bros., New York, N. Y.
159. George G. Fries & Co., Inc., New York, N. Y.
160. Funk Bros., Bloomington, Ill.
161. General Aniline Works, Inc., New York, N. Y.
162. General Chemical Co., New York, N. Y.
163. Genesee Chemical Co., Genesee, Pa.
164. Glyco Products, Inc., New York, N. Y.
165. Givaudan-Delawanna, Inc., New York, N. Y.
166. Glidden Co., Cleveland, Ohio
167. W. H. Gould & Co., San Francisco, Calif.
168. Gray Chemical Co., New York, N. Y.
169. Great Lakes Chemical Corp., Filer City, Mich.
170. Great Western Electrochem. Corp., San Francisco, Calif.
171. A. Gross & Co., New York, N. Y.
172. Gulf Oil Corp., Port Arthur, Tex.
173. Gulf States Steel Co., Birmingham, Ala.
174. W. C. Hardesty Co., Inc., New York, N. Y.
175. Harford Talc & Quartz Co., Towson, Md.
176. Harkness & Cowing Co., Cincinnati, Ohio
177. Harmon Color Works, Inc., Paterson, N. J.
178. Harshaw Chemical Co., Cleveland, Ohio
179. Heineman Chemical Co., Crosby, Pa.
180. Hercules Powder Co., Wilmington, Del.

MANUFACTURERS OF CHEMICALS AND RELATED PRODUCTS

181. Heyden Chemical Corp., New York, N. Y.
182. Hilton Davis Chemical Co., Cincinnati, Ohio
183. O. Hommel Co., Pittsburgh, Pa.
184. Hooker Electrochemical Co., Niagara Falls, N. Y.
185. Horse Heaven Mines, Inc., Philadelphia, Pa.

186. J. M. Huber Corp., New York, N. Y.
187. James Huggins & Son, Malden, Mass.
188. Illinois Smelting & Refining Co., Chicago, Ill.
189. Imperial Oil & Gas Products Co., Pittsburgh, Pa.
190. Imperial Paper & Color Corp., Glens Falls, N. Y.

191. Indiana Oxygen Co., Indianapolis, Ind.
192. Industrial Chemical Sales Co., New York, N. Y.
193. Inland Steel Co., Chicago, Ill.
194. Innis Speiden & Co., New York, N. Y.
195. International Agricultural Chemical Co., New York N. Y.

196. International Pulp Co., New York, N. Y.
197. International Smelting & Refining Co., East Chicago, Ind.
198. Io-Dow Chemical Co., Midland, Mich.
199. Iowa Milling Co., Cedar Rapids, Iowa.
200. Irvington Smelting & Refining Works, Irvington, N. J.

201. James Mfg. Co., Kane, Pa.
202. Jardine Mining Co., Jardine, Mont.
203. Jasco, Inc., Baton Rouge, La.
204. Jefferson Lake Oil Co., Freeport, Tex.
205. Jennison-Wright Co., Toledo, Ohio

206. Charles Eneu Johnson & Co., Philadelphia, Pa.
207. Jones & Laughlin Steel Corp., Pittsburgh, Pa.
208. Kay-Fries Chemicals, Inc., New York, N. Y.
209. Keasbey & Mattison Co., Ambler, Pa.
210. Thomas Keery Co., Inc., Hancock, N. Y.

211. Kentucky Color & Chemical Co., Louisville, Ky.
212. Kessler Chemical Corp., Philadelphia, Pa.
213. H. Kohnstamm & Co., Inc., New York, N. Y.
214. Kinzua Valley Chemical Co., Morrison, Pa.
215. Koppers Co., Pittsburgh, Pa.

216. Land O' Lakes Creameries, Minneapolis, Minn.
217. Larkin Co., Inc., Buffalo, N. Y.
218. Latimer-Goodwin Chemical Co., Grand Junction, Colo.
219. I. F. Laucks, Portsmouth, Va.
220. Fred L. Lavanburg Co., Inc., Brooklyn, N. Y.

221. Lehigh Briquetting Co., Fargo, N. D.
222. Charles Lennig & Co., Philadelphia, Pa.
223. Lever Bros, Cambridge, Mass.
224. John T. Lewis & Bros. Co., Philadelphia, Pa.
225. Lewis Run Mfg. Co., Lewis Run, Pa.

226. Linde Air Products Co., New York, N. Y.
227. Lindsay Light and Chemical Co., West Chicago, Ill.
228. Liquid Carbonic Corp., Chicago, Ill.
229. Liverpool Salt Co., Hartford, W. Va.
230. W. H. Loomis Talc Corp., Gouverneur, N. Y.

231. Los Angeles Chemical Co., Los Angeles, Calif.
232. Los Angeles Soap Co., Los Angeles, Calif.
233. Lucas Kil-Tone Co., Vineland, N. J.
234. George Lueders & Co., New York, N. Y.
235. A. R. Maas Chemical Co., Los Angeles, Calif.

236. Magnetic Pigment Co., Trenton, N. J.
237. Magnolia Petroleum Co., Beaumont, Tex.
238. Mallinckrodt Chemical Works, St. Louis, Mo.
239. P. B. de Mandel, Santa Barbara, Calif.
240. Mangelsdorf Soya Bean Co., Achison, Kan.

241. Marine Chemicals Co., South San Francisco, Calif.
242. L. Martin Co., New York, N. Y.
243. A. Maschmeijer, Jr., Inc., New York, N. Y.
244. Matheson Co., E. Rutherford, N. J.
245. Mathieson Alkali Works, Inc., New York, N. Y.

246. J. M. Mathison, Asheville, Ala.
247. Maywood Chemical Works, Maywood, N. J.
248. McGean Chemical Co., Cleveland, Ohio
249. Merck & Co., Inc., New York, N. Y.
250. Metal & Thermit Corp., New York, N. Y.

251. Metal Detinning Co., Pittsburgh, Pa.
252. Metals Disintegrating Co., Elizabeth, N. J.
253. Michigan Alkali Co., New York, N. Y.
254. Michigan Chemical Corp., St. Louis, Mich.
255. Mid-Continent Quicksilver Co., Amity, Ark.

256. Midland Ammonia Co., Midland, Mich.
257. Midland Electric Coal Corp., Indianapolis, Ind.
258. Midwest Carbide Corp., Keokuk, Iowa
259. Mineral Pigments Co., Muirkirk, Md.
260. Mineral Products Co., West Mineral, Kan.

261. Monsanto Chemical Co., St. Louis, Mo.
262. Moore County Carbon Co., Bartlesville, Okla.
263. Morton Salt Co., Chicago, Ill.
264. Mountain Copper Co., San Francisco, Calif.
265. Mutual Chemical Company of America, New York, N. Y.

266. National Aluminate Corp., Chicago, Ill.
267. National Ammonia Co., Philadelphia, Pa.
268. National Aniline & Chemical Co., New York, N. Y.
269. National Carbide Corp., New York, N. Y.
270. National Carbon Co., New York, N. Y.

271. National Carbonic Co., San Antonio, Tex.
272. National Casein Sales Co., Chicago, Ill.
273. National Cylinder Gas Co., St. Louis, Mo.
274. National Dairy Products, New York, N. Y.
275. National Lead Co., New York, N. Y.

276. National Oil Products Co., Harrison, N. J.
277. National Zinc Co., Bartlesville, Okla.
278. Natural Products Refining Co., Jersey City, N. J.
279. Naugatuck Chemical Co., New York, N. Y.
280. Neville Co., Pittsburgh, Pa.

281. Newberry Chemical & Lumber Co., Newberry, Mich.
282. New Jersey Zinc Co., New York, N. Y.
283. Newport Industries, Inc., New York, N. Y.
284. New York Quinine & Chemical Works, Brooklyn, N. Y.
285. Niacet Chemical Co., New York, N. Y.

286. Niagara Alkali Co., New York, N. Y.
287. Niagara Chlorine Products Corp., Lockport, N. Y.
288. Niagara Smelting Corp., New York N. Y.
289. Niagara Sprayer & Chemical Co., Inc., Middleport, N. Y.
290. Nichols Copper Co., New York, N. Y.

MANUFACTURERS OF CHEMICALS AND RELATED PRODUCTS

291. Nord & Schulich Inc., Newark, N. J.
292. North American Cement Corp., Albany, N. Y.
293. Northwestern Chemical Co., Wauwatosa, Wis.
294. Nu-Ice Corp., Los Angeles, Calif.
295. Ohio Apex, Inc., Nitro, W. Va.

296. Ohio Chemical & Mfg. Co., Cleveland, Ohio
297. Ohio River Salt Corp., Mason, W. Va.
298. Oldbury Electro Chemical Co., Niagara Falls, N. Y.
299. Old Fort Mills, Marion, Ohio
300. Oswego Chemical Co., Coneville, Pa.

301. Otto Chemical Co., Sargent, Pa.
302. Ozark Chemical Co., Tulsa, Okla.
303. Pacific Alkali Co., Bartlett, Calif.
304. Pacific Ammonia Co., Seattle, Wash.
305. Pacific Coast Borax Co., New York, N. Y.

306. Pacific Coast Talc Co., Los Angeles, Calif.
307. Pacific Silicate Co., San Francisco, Calif.
308. Pacific Vegetable Oil Corp., San Francisco, Calif.
309. Parker Browne Co., Fort Worth, Tex.
310. Peabody Coal Co., Chicago, Ill.

311. Peerless Carbon Black Co., Pittsburgh, Pa.
312. Penick & Ford, New York, N. Y.
313. Penn Charcoal & Chemical Co., Smithport, Pa.
314. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
315. Pennsylvania Sugar Co., Philadelphia, Pa.

316. Penn-Wood Products Corp., Caryville, Pa.
317. Charles Pfizer & Co., Inc., New York, N. Y.
318. Phelps Dodge Refining Corp., New York, N. Y.
319. Philadelphia Quartz Co., Philadelphia, Pa.
320. Piel Brothers Starch Co., Indianapolis, Ind.

321. Pittsberg Chemical Co., San Francisco, Calif.
322. Pittsburgh Plate Glass Co., Pittsburgh, Pa.
323. Plant Rubber Asbestos Works, San Francisco, Calif.
324. Pomeroy Salt Corp., Pomeroy, Ohio
325. Portland Gas & Coke Co., Portland, Oregon

326. Potash Company of America, Baltimore, Md.
327. Prince Mfg. Co., Bowmanstown, Pa.
328. Procter & Gamble, Cincinnati, Ohio
329. Publicker, Inc., Philadelphia, Pa.
330. Pulaski Bauxite Co., Little Rock, Ark.

331. Pure Carbonic Company of America, New York, N. Y.
332. Puritan Compressed Gas Corp., Kansas City, Mo.
333. Quicksilver Syndicate, Blackbutte, Ore.
334. Rademaker Chemical Corp., Eastlake, Mich.
335. Ralston Purina Co., St. Louis, Mo.

336. Ranier Brewing Co., San Francisco, Calif.
337. Raritan Copper Works, Perth Amboy, N. J.
338. Reilly Tar & Chemical Corp., Indianapolis, Ind.
339. Republic Creosoting Co., Indianapolis, Ind.
340. Republic Mining & Mfg. Co., New York, N. Y.

341. Rhodes Alkali & Chemical Corp., Mina, Nev.
342. John A. Roebling & Sons, Trenton, N. J.
343. Rohm & Haas Co., Philadelphia, Pa.
344. Royal Baking Powder Co., New York, N. Y.
345. Royce Chemical Co., Carlton Hill, N. J.

346. F. S. Royster Guano Co., Norfolk, Va.
347. Rubberoid Co., New York, N. Y.
348. Rumford Chemical Works, Rumford, R. I.
349. St. Joseph Lead Co., New York, N. Y.
350. Salvo Chemical Corp., Rothschild, Wis.

351. San Benito Mining Co., San Benito, Calif.
352. Santa Ynez Mercury Corp., Santa Ynez, Calif.
353. Seaboard Operating Co., Baltimore, Md.
354. Sharples Solvents Corp., Philadelphia, Pa.
355. Shawinigan Products Corp., New York, N. Y.

356. Sheffield By-Products Co., New York, N. Y.
357. Shell Chemical Co., San Francisco, Calif.
358. The Sherwin-Williams Co., Cleveland, Ohio
359. Sierra Talc Co., Los Angeles, Calif.
360. C. F. Simonin's Sons, Philadelphia, Pa.

361. Solvay Process Co., New York, N. Y.
362. L. Sonneborn & Sons, New York, N. Y.
363. Southern Alkali Corp., Corpus Christi, Tex.
364. Southern Mineral Products Corp., New York, N. Y.
365. Southern Oxygen Co., So. Washington, Va.

366. Southern Talc Co., Chatsworth, Ga.
367. Sparkling Carbonic Co., Cincinnati, Ohio
368. Spencer-Kellogg & Sons Co., Buffalo, N. Y.
369. A. E. Staley Mfg. Co., Decatur, Ill.
370. Standard Alcohol Co., New York, N. Y.

371. Standard Brands, Inc., New York, N. Y.
372. Standard Chromate Co., Painesville, O.
373. Standard Silicate Co., Cincinnati, Ohio
374. Standard Soybean Mills, Centerville, Iowa
375. Standard Ultramarine Co., Huntington, W. Va.

376. Stanwix Products Corp., Brooklyn, N. Y.
377. Stauffer Chemical Co., San Francisco, Calif.
378. Sterling Borax Co., Chicago, Ill.
379. Sulphur Products Co., Inyo County, Calif.
380. Superior Chemical Co., Joliet, Ill.

381. Swann & Co., Birmingham, Ala.
382. Synthetic Iron Color Co., Richmond, Calif.
383. The Synthetic Products Co., Cleveland, Ohio
384. Talc Mining & Milling Corp., Jersey City, N. J.
385. The Tannin Corp., New York, N. Y.

386. Taylor White Extracting Co., Camden, N. J.
387. Tennessee Corp., New York, N. Y.
388. Tennessee Eastman Corp., Kingsport, Tenn.
389. Tennessee Products Corp., Lyles-Wrigley, Tenn.
390. Texas Chemical Co., New York, N. Y.

391. Texas Gulf Sulphur Co., Inc., New York, N. Y.
392. Thermatomic Carbon Co., New York, N. Y.
393. Thomas & Skeoch, Tecopa, Calif.
394. Thompson-Hayward Chemical Co., Kansas City, Mo.
395. O. & W. Thum Co., Grand Rapids, Mich.

396. Tionesta Valley Chemical Co., Mayburg, Pa.
397. A. M. Todd Co., Kalamazoo, Mich.
398. Trojan Powder Co., Allentown, Pa.
399. Twin City Milk Producers Assn., St. Paul, Minn.
400. Paul Uhlich & Co., Inc., New York, N. Y.

MANUFACTURERS OF CHEMICALS AND RELATED PRODUCTS

401. Union Carbide Co., New York, N. Y.
402. Union Charcoal Co., Westline, Pa.
403. Union Starch & Refining Co., Columbus, Ind.
404. United Carbon Co., Charleston, W. Va.
405. United Color & Pigment Co., Newark, N. J.
406. U. S. Industrial Alcohol Co., New York, N. Y.
407. U. S. Industrial Chemicals, Inc., New York, N. Y.
408. U. S. Potash Co., New York, N. Y.
409. U. S. Smelting, Refining & Mining Co., New York, N. Y.
410. Utah Sulphur Industries, Beaver, Utah.
411. Valley Mining Co. Inc., Los Angeles, Calif.
412. Van Ameringen-Haebler, Inc., New York, N. Y.
413. Vermont Mineral Products, Chester, Vt.
414. Vermont Talc Co., Chester, Vt.
415. Verona Chemical Co., Newark, N. J.
416. Victor Chemical Works, Chicago, Ill.
417. Victor Sharp, Gulch Mine, Inyo Co., Calif.
418. Vinegar Hill Zinc Co., Cuba City, Wisc.
419. Virginia Carolina Chemical Corp., Richmond, Va.
420. Virginia Smelting Co., Boston, Mass.
421. Vitro Mfg. Co., Pittsburgh, Pa.
422. Vulcan Detinning Co., Sewaren, N. J.
423. Wall Chemicals, Detroit, Mich.
424. Washington Liquid Gas Co., Seattle, Wash.
425. M. Werk Co., Cincinnati, O.
426. West End Chemical Co., Oakland, Calif.
427. Western Dry Color Co., Chicago, Ill.
428. Western Talc Co., Los Angeles, Calif.
429. Westvaco Chlorine Products Co. Inc., New York, N. Y.
430. West Virginia Pulp & Paper Co., New York, N. Y.
431. Westwell Chemical Co., Whittier, Calif.
432. Weyman Chemical Co., Port Allegheny, N. Y.
433. S. S. White Dental Mfg. Co., Phila., Pa.
434. Whiting Milk Co., Boston, Mass.
435. Will & Baumer Candle Co. Inc., Syracuse, N. Y.
436. C. K. Williams Co., Easton, Pa.
437. Wilson & Co., Chicago, Ill.
438. Wishnick Tumpeer, Inc., New York, N. Y.
439. Jacques Wolf & Co., Passaic, N. J.
440. J. S. Young Co., Baltimore, Md.
441. Zero Ice Corp., Detroit, Mich.
442. Zinsser & Co., Inc., Hastings-on-Hudson, N. Y.

SULPHURIC ACID PLANTS IN THE UNITED STATES, 1939

THE FOLLOWING LIST of sulphuric acid plants in the United States includes only plants that have been in recent regular operation. A few plants which have not been run in recent years may possibly be available for use should war conditions make their operation necessary. The list is based on previously published material, corrected as far as possible from available trade information. In the list, the letter C *indicates a contact process plant,* Ch, *a chamber process sulphuric acid plant*

Company	Type of Plant	Location
Alabama:		
American Agricultural Chemical Co.	Ch	Montgomery
E. I. du Pont de Nemours & Co., Inc.	C	Mineral Springs
Home Guano Co.	Ch	Dothan
Standard Chemical Co.	Ch	Troy
Steel Cities Chemical Co.	Ch	Exum
Virginia-Carolina Chemical Corp.	Ch	Dothan
	Ch	Mobile
	C	Birmingham
Arizona:		
Apache Powder Co., Inc.	C	Douglas
Phelps Dodge Corp.	Ch	Douglas
California:		
American Smelting & Refining Co.	C	Selby
Dominguez Chemical Co.	C	Dominguez
General Chemical Co.	C	Bay Point
	C	El Segundo
Hercules Powder Co.	C	Hercules
Hughes-Mitchell, Inc.	C	Torrance
Stauffer Chemical Co.	Ch & C	Vernon
	C	Stege
Colorado:		
E. I. du Pont de Nemours & Co., Inc.	C	Louviers
General Chemical Co.	C	Denver
Connecticut:		
American Cyanamid & Chemical Co.	Ch	Waterbury
Naugatuck Chemical Co.	Ch & C	Naugatuck
Florida:		
American Agricultural Chemical Co.	Ch	Pensacola
Armour Fertilizer Works	Ch	Jacksonville
U. S. Phosphoric Products Corp.	C	East Tampa
Wilson & Toomer Fertilizer Co.	Ch	Jacksonville
Georgia:		
American Agricultural Chemical Co.	Ch	Savannah
Armour Fertilizer Works	Ch	Albany
	Ch	Atlanta
	Ch	Columbus
Cotton States Fertilizer Co.	Ch	Macon
Empire State Chemical Co.	Ch	Athens
Georgia Fertilizer Co.	Ch	Valdosta

MANUFACTURERS OF CHEMICALS AND RELATED PRODUCTS

Company	Type of Plant	Location
International Agricultural Corp.	Ch	Columbus
Mutual Fertilizer Co.	Ch	Savannah
Pelham Phosphate Co.	Ch	Pelham
Reliance Phosphate Co.	Ch	Savannah
F. S. Royster Guano Co.	Ch	Macon
Southern Fertilizer & Chemical Co.	Ch	Savannah
Southern States Phosphate & Fertilizer Co.	Ch	Savannah
Virginia-Carolina Chemical Corp.	Ch	Augusta
	Ch	Rome
	Ch	Savannah
Illinois:		
American Cyanamid Co.	C	Joliet
American Zinc, Lead & Smelting Co.	Ch	East St. Louis
	Ch	Hillsboro
Armour Fertilizer Works	Ch	Chicago Heights
Central Chemical Co.	Ch	Calumet City
General Chemical Co.	C	East St. Louis
	C	Hegewisch
Hegeler Zinc Co.	Ch	Danville
Matthiessen & Hegeler Zinc Co.	Ch	La Salle
Monsanto Chemical Co.	Ch & C	East St. Louis
New Jersey Zinc Co.	C	Depue
Indiana:		
E. I. du Pont de Nemours & Co., Inc.	Ch & C	East Chicago
Standard Oil Co. of Indiana	C	Whiting
Stauffer Chemical Co. of Ind.	C	East Hammond
Kentucky:		
E. I. du Pont de Nemours & Co., Inc.	C	Wurtland
Louisiana:		
Armour Fertilizer Works	Ch	New Orleans
Louisiana Chemical Co., Inc.	C	Baton Rouge
Southern Acid & Sulphur Co., Inc.	C	Bossier City
Swift & Co.	Ch	Harvey
Virginia-Carolina Chemical Corp.	Ch	Shreveport
Maryland:		
American Agricultural Chemical Co.	Ch	Baltimore
Baugh Chemical Co.	Ch	Baltimore
Davison Chemical Co.	Ch & C	Baltimore
Naval Powder Factory	C	Indian Head
F. S. Royster Guano Co.	Ch	Baltimore
Standard Wholesale Phosphate & Acid Works, Inc.:		
Consumers Acid Works	C	Baltimore
Union Acid Works	Ch	Baltimore
Massachusetts:		
American Agricultural Chemical Co.	Ch	North Weymouth
Montsanto Chemical Co.	C	Everett
Michigan:		
American Agricultural Chemical Co.	Ch	Detroit
Detroit Chemical Works	Ch	Detroit

Company	Type of Plant	Location
E. I. du Pont de Nemours & Co., Inc.	C	Ecorse
Mississippi:		
Gulfport Fertilizer Co.	Ch	Gulfport
Jackson Fertilizer Co.	Ch	Jackson
International Agricultural Corp.	Ch	Tupelo
Missouri:		
Atlas Powder Co.	C	Atlas
Titanium Pigment Co.	C	St. Louis
Montana:		
Anaconda Copper Mining Co.	Ch	Anaconda
New Jersey:		
American Agricultural Chemical Co.	Ch	Carteret
American Cyanamid Co.	Ch & C	Warners
Armour Fertilizer Works	Ch	Carteret
Calco Chemical Co.	C	Bound Brook
E. I. du Pont de Nemours & Co., Inc.	C	Deepwater Point
	Ch & C	Grasselli
	Ch	Newark
	Ch	Paulsboro
General Chemical Co.	C	Edgewater
Titanium Pigment Co.	C	Sayreville
New York:		
American Agricultural Chemical Co.	Ch	Buffalo
Eastman Kodak Co.	C	Rochester
General Chemical Co.	Ch & C	Buffalo
North Carolina:		
Acme Manufacturing Co.	Ch	Wilmington
Armour Fertilizer Works	Ch	Greensboro
	Ch	Navassa
Merchants Phosphate Fertilizer Co.	Ch	Charlotte
Swift & Co.	Ch	Wilmington
Virginia-Carolina Chemical Corp.	Ch	Durham
	Ch	Selma
	Ch	Wadesboro
	Ch	Wilmington
Ohio:		
American Agricultural Chemical Co.	Ch	Cleveland
E. I. du Pont de Nemours & Co., Inc.	Ch	Canton
	Ch	Cleveland
	Ch	Lockland
	Ch	Niles
	C	Toledo
Farmers Fertilizer Co.	Ch	Columbus
General Chemical Co.	Ch & C	Willow
Armour Fertilizer Works	Ch	Sandusky
F. S. Royster Guano Co.	C	Toledo
Smith Agricultural Chemical Co.	Ch	Columbus
Virginia-Carolina Chemical Corp.	C	Cincinnati
Oklahoma:		
National Zinc Co.	C	Bartlesville
Ozark Chemical Co.	C	Tulsa

(*Please turn to page* 604)

Consumption of Fuel and Purchased

For the first time since 1929 the Bureau of the Census has made available data on the quantity of fuel and purchased electric energy utilized by manufacturing industry in

Industry	FUEL				
		Coal			
	Total Cost[1]	Anthracite Short Tons	Bituminous Short Tons	Coke, Short Tons	Fuel Oil, Bbl.
Artificial leather	$372,154	9,954	33,657	1,656	71,811
Asphalted-felt-base floor covering	482,268	21,104	29,463	....	78,352
Blacking, stains, and dressings	80,104	181	7,647	99	22,849
Bluing	1,471	8	50	4	248
Bone black, carbon black, and lampblack	29,617	12	802	....	4,863
Candles	77,258	87	9,158	5	10,143
Cement	24,936,088	119,129	8,550,269	1,472	2,459,633
Chemicals not elsewhere classified	35,442,569	280,462	5,043,533	386,159	4,627,004
Clay products, other than pottery	20,695,876	152,195	6,002,895	30,788	1,392,767
Cleaning and polishing preparations	190,801	1,642	19,815	245	19,925
Coke-oven products	11,142,845	18,472	68,675,491	404,243	10,395
Compressed and liquefied gases	358,351	4,986	37,795	8,435	34,442
Drug grinding	98,934	181	24,371	....	363
Drugs and medicines	1,135,629	20,416	96,572	784	209,520
Explosives	976,750	31,032	124,387	1,354	357,820
Fertilizers	826,586	5,453	90,515	827	249,229
Fireworks and allied products	86,547	187	9,838	....	21,370
Fuel briquettes	70,873	130,251	15,803	....	....
Glass	21,138,343	4,411	1,172,976	2,208	924,177
Glue and gelatin	1,739,109	204	335,589	315	244,839
Graphite, ground and refined	4,172	244	250	5	234
Grease and tallow, not including lubricating greases	1,360,063	10,867	257,784	2,449	54,319
Gypsum products	1,308,663	2,821	145,831	2,651	246,781
Ink, printing	186,304	2,520	12,523	55	47,304
Ink, writing	13,995	441	711	....	4,276
Insecticides and fungicides, and industrial and household chemical compounds not elsewhere classified	462,292	6,429	50,257	529	75,442
Leather: Tanned, curried, and finished — regular factories	4,033,116	46,190	773,616	22	198,309
Leather: Tanned, curried, and finished — contract factories	236,745	591	31,134	311	13,334
Lime	4,744,962	53,301	816,286	47,246	268,146
Linoleum	374,067	92,989	....	....	13,671
Liquors, distilled	2,437,220	21,957	735,882	178	113,857
Lubricating oils and greases, not made in petroleum refineries	433,331	2,770	59,640	56	690,781
Matches	269,879	....	69,140	....	4,271
Minerals and earths, ground or otherwise treated	824,213	3,664	61,656	2,142	188,727
Mucilage, paste, and other adhesives, except glue and rubber cement	32,022	306	3,500	3	2,294
Nonclay refractories	2,301,595	3,892	562,157	11	127,620
Oil, cake, and meal, cottonseed	2,112,895	16,524	296,874	5,000	149,950
Oil, cake, and meal, linseed	423,397	....	33,181	494	209,264
Oilcloth	162,865	6,363	24,898	....	14,995
Oils, essential	46,464	563	7,920	12	962
Oils, not elsewhere classified	596,190	360	77,408	2,149	152,606
Paints, pigments, and varnishes	4,294,087	86,611	427,422	36,883	777,836
Paper	43,461,133	980,258	7,233,311	62,941	3,333,734
Paving materials: Blocks (except brick and stone) and mixtures	718,221	4,621	177,357	245	254,077
Perfume, cosmetics, and other toilet preparations	245,000	7,656	15,691	20	61,324
Petroleum refining	83,664,861	30,074	1,232,411	81,163	34,848,089
Pottery, including porcelain ware	3,822,546	66,497	277,883	226	458,887
Pulp (wood and other fiber)	13,263,151	174,832	7,756,670	18,749	1,409,925
Rayon and allied products	5,654,322	7,250	1,554,191	....	722,754
Roofing, built-up and roll; asphalt shingles; roof coatings other than paint	1,500,673	10,936	124,008	6,210	512,535
Rubber goods other than tires, inner tubes, and boots and shoes	2,978,943	80,238	1,032,525	285	436,306
Rubber tires and inner tubes	4,395,850	....	1,279,037	200	24,843
Salt	2,297,412	57,313	504,247	229	48,438
Sand-lime brick	73,892	460	11,916	491	9,630
Soap	2,773,335	18,695	457,545	....	523,149
Sugar, beet	4,666,095	1	892,609	52,820	62,434
Sugar, cane, not including products of refineries	1,005,677	5,131	3,122	....	674,535
Sugar, refining, cane	5,194,602	159,632	367,615	....	1,282,896
Tanning materials, natural dyestuffs, mordants and assistants, and sizes	670,651	7,022	134,644	141	54,558
Turpentine and rosin	495,280	....	600	....	200
Wallboard and plaster (except gypsum), building insulation, and floor composition	1,830,325	623	104,859	79,006	252,564
Wood distillation and charcoal manufacture	1,093,666	199	170,251	11,450	63,974
Wood preserving	1,742,084	15,654	312,467	550	154,920

[1] Includes cost of fuels, such as wood, gasoline, etc., not shown in table

Energy in the Process Industries, 1937

the United States. **CHEM. & MET.** ***lists here in alphabetical order those data pertaining to the chemical process industries as defined on page 542.***

Gas (nat. & mfd.) M cu. ft.	PURCHASED ELECTRIC ENERGY: Total Cost	Quantity and Cost Reported: Kw.-hr.	Quantity and Cost Reported: Cost	Quantity Not Reported, Cost	Industry
541	$201,386	15,571,397	$200,482	$904	Artificial leather
284,733	145,390	12,647,904	145,390	....	Asphalted-felt-base floor covering
254,589	49,823	1,571,443	46,029	3,794	Blacking, stains, and dressings
220,400	1,448	33,103	961	487	Bluing
108,513	277,511	35,432,913	277,400	111	Bone black, carbon black, and lampblack
14,145	20,557	541,035	20,557	....	Candles
40,049,138	9,380,597	1,298,795,482	9,380,597	....	Cement
50,365,154	27,156,112	7,885,849,174	27,134,523	21,589	Chemicals not elsewhere classified
45,104,832	4,158,137	235,172,352	4,119,104	39,033	Clay products, other than pottery
81,922	204,655	9,338,996	193,016	11,639	Cleaning and polishing preparations
241,623,579	1,842,887	259,518,999	1,842,341	546	Coke-oven products
270,804	3,054,118	311,785,999	3,051,202	2,916	Compressed and liquefied gases
122	61,645	2,927,118	61,518	127	Drug grinding
182,020	768,423	33,011,289	728,784	39,639	Drugs and medicines
312,855	555,049	63,329,069	553,852	1,197	Explosives
330,253	1,747,443	127,450,206	1,704,364	43,079	Fertilizers
12,413	74,266	3,739,483	72,761	1,505	Fireworks and allied products
....	167,129	12,117,613	167,129	....	Fuel briquettes
93,456,425	5,603,696	653,290,445	5,601,990	1,706	Glass
508,407	170,017	19,776,849	168,444	1,573	Glue and gelatin
....	7,885	285,861	7,885	....	Graphite, ground and refined
682,107	607,875	28,859,361	596,950	10,925	Grease and tallow, not including lubricating greases
2,125,497	1,070,596	91,704,229	1,068,930	1,666	Gypsum products
33,802	503,402	20,906,653	495,301	8,101	Ink, printing
490	9,743	345,552	9,613	130	Ink, writing
139,416	285,187	11,838,943	266,754	18,433	Insecticides and fungicides, and industrial and household chemical compounds not elsewhere classified
812,936	1,589,089	100,845,780	1,582,930	6,159	Leather: Tanned, curried, and finished — regular factories
87	130,280	4,657,054	125,673	4,607	Leather: Tanned, curried, and finished — contract factories
1,875,260	1,309,606	93,362,875	1,308,557	1,049	Lime
7,089	419,570	48,229,310	419,570	....	Linoleum
·417,412	483,442	31,151,598	481,363	2,079	Liquors, distilled
1,248,006	183,228	10,086,053	176,051	7,177	Lubricating oils and greases, not made in petroleum refineries
3,648	102,732	6,576,906	102,732	....	Matches
950,619	1,004,140	77,684,498	1,003,799	341	Minerals and earths, ground or otherwise treated
64,477	44,118	1,920,425	42,975	1,143	Mucilage, paste, and other adhesives, except glue and rubber cement
420,793	494,154	36,885,695	494,154	....	Nonclay refractories
5,009,745	2,297,490	205,389,858	2,288,495	8,995	Oil, cake, and meal, cottonseed
19,633,657	372,115	38,941,546	371,936	179	Oil, cake, and meal, linseed
....	42,108	3,275,070	42,108	....	Oilcloth
3,180	8,881	308,830	8,881	....	Oils, essential
76,489	713,552	50,752,151	711,133	2,419	Oils, not elsewhere classified
2,318,182	3,248,214	210,908,072	3,180,317	67,897	Paints, pigments, and varnishes
15,969,256	15,529,599	2,010,805,317	15,511,937	17,662	Paper
54,150	230,495	7,186,113	189,405	41,090	Paving materials: Blocks (except brick and stone) and mixtures
54,431	234,005	6,482,320	215,603	18,402	Perfume, cosmetics, and other toilet preparations
604,553,600	9,471,011	1,287,105,230	9,462,965	8,046	Petroleum refining
6,063,789	977,039	59,740,192	967,358	9,681	Pottery, including porcelain ware
10,011,981	5,925,897	1,023,599,147	5,925,897	....	Pulp (wood and other fiber)
83,613	1,721,681	288,840,421	1,721,070	611	Rayon and allied products
865,028	493,929	34,627,600	491,457	2,472	Roofing, built-up and roll; asphalt shingles; roof coatings other than paint
5,621,653	4,336,561	369,982,625	4,328,238	8,323	Rubber goods other than tires, inner tubes, and boots and shoes
2,315,116	4,323,168	590,709,518	4,323,168	....	Rubber tires and inner tubes
3,880,427	254,386	17,906,736	252,220	2,166	Salt
....	47,709	1,713,498	47,580	129	Sand-lime brick
1,535,682	625,940	56,887,762	619,744	6,196	Soap
8,043,319	176,967	8,691,080	176,967	....	Sugar, beet
943,640	50,772	1,755,201	49,438	1,334	Sugar, cane, not including products of refineries
10,353,896	111,107	10,482,608	110,805	302	Sugar, refining, cane
1,007,622	317,374	69,302,815	310,897	6,477	Tanning materials, natural dyestuffs, mordants and assistants, and sizes
....	12,518	423,679	9,291	3,227	Turpentine and rosin
11,505,286	1,136,171	168,249,736	1,131,046	5,125	Wallboard and plaster (except gypsum), building insulation, and floor composition
1,846,516	214,252	17,251,076	210,972	3,280	Wood distillation and charcoal manufacture
1,021,232	420,087	19,418,116	398,100	21,987	Wood preserving

SULPHURIC ACID PLANTS — *Cont'd from page 601*

Company	Type of Plant	Location
PENNSYLVANIA:		
American Cyanamid Co.	Ch	Erie
American Sheet & Tin Plate Co.	Ch	Vandergrift
American Steel & Wire Co.	Ch	Donora
American Zinc & Chemical Co.	Ch	Langeloth
Atlantic Refining Co.	C	Philadelphia
Daugherty & Son Refining Co.	C	Petrolia
E. I. du Pont de Nemours & Co., Inc.	Ch	Newcastle
	Ch & C	Philadelphia
General Chemical Co.	C	Marcus Hook
	C	Newell
Chas. Lennig & Co.	Ch & C	Philadelphia
New Jersey Zinc Co.	C	Palmerton
Pennsylvania Salt Manufacturing Co.	C	Natrona
	C	Philadelphia
St. Joseph Lead Co.	C	Josephtown
RHODE ISLAND:		
Rumford Chemical Works.	C	Rumford
SOUTH CAROLINA:		
American Agricultural Chemical Co.	Ch	Charleston
	Ch	Columbia
Anderson Fertilizer Co., Inc.	Ch	Anderson
Davison Chemical Co.	Ch	Charleston
Etiwan Fertilizer Co.	Ch	Charleston
Maybank Fertilizer Co.	Ch	Charleston
Merchants Phosphate & Fertilizer Co.	Ch	Charleston
Planters Fertilizer & Phosphate Co.	Ch	Charleston
Virginia-Carolina Chemical Corp.	Ch	Charleston
	Ch	Greenville
TENNESSEE:		
Armour Fertilizer Works.	Ch	Nashville
Davison Chemical Co.	Ch	Nashville
Tennessee Corp.	Ch	Copper Hill
	Ch & C	Isavella
Virginia-Carolina Chemical Corp.	Ch	Memphis
TEXAS:		
Armour Fertilizer Works.	Ch	Houston
Gulf Refining Co.	C	Port Arthur
Southern Acid & Sulphur Co., Inc.	C	Chaison
	C	Port Arthur
Stauffer Chem. Co.	Ch	Harrys
Texas Chemical Co.	C	Fort Worth
	C	Houston
UTAH:		
Garfield Chemical Manufacturing Corp.	C	Garfield
VIRGINIA:		
American Agricultural Chemical Co.	Ch	Alexandria
General Chemical Co.	C	Pulaski
Robertson Chemical Corp.	Ch	Norfolk
F. S. Royster Guano Co.	Ch	Norfolk
Smith-Douglas, Inc.	C	Norfolk
Virginia-Carolina Chemical Corp.	Ch	Lynchburg
	Ch	Pinners Point
	Ch	Richmond
Virginia Chemical Corp.	C	Piney River
WASHINGTON:		
E. I. du Pont de Nemours & Co., Inc.	C	Du Pont
WEST VIRGINIA:		
Carbide & Carbon Chemical Corp.	C	South Charleston
United Zinc Smelting Corp.	Ch	Moundsville
WISCONSIN:		
E. I. du Pont de Nemours & Co., Inc.	C	Barksdale
Vinegar Hill Zinc Co.	C	Cuba City
WYOMING:		
Standard Oil Co. of Indiana.	C	Casper

FOREIGN TRADE

(*Continued from page* 569)

gains in the first half of the current year included vegetable tanning extracts, shipments of which increased in value from $612,000 to $716,600; industrial chemicals, from $12,369,000 to $13,052,000; essential oils, from $1,147,000 to $1,296,000; fertilizers, from $7,753,000 to $7,859,000; soaps, from $1,337,600 to $1,393,600; and toilet preparations, from $2,932,500 to $3,139,000.

A survey made by the Bureau of Foreign and Domestic Commerce brings out two points which have had a bearing on international trade. First is the move on the part of many countries to accumulate surplus stocks of basic materials, deliveries of which might be interrupted in the period of war. The other, and much less favorable, is the enumeration of numerous difficulties which hamper the movement of chemicals from one country to another. Among these difficulties are strict enforcement of financial regulations, lack of foreign exchange, use of artificial measures of trade such as aski-marks, quota restrictions, barter transactions, high duties, and import and export embargoes. The survey further showed that there was almost complete control of foreign trade in one way or another in most of the European countries and in some sections of the Far East.

The drop in world foreign trade last year is accounted for in various ways. Some foreign countries were confronted with a decline in industrial activities and work at chemical plants was curtailed accordingly. Hence there was a lessened demand for raw materials both domestic and foreign and buying for import was on a lower scale. In other countries where manufacturing activities were relatively high, stocks accumulated in the preceding year were drawn upon and cut down necessity for imports.

Elucidating on this situation it is reported that last year was characterized by irregularities and uncertainties and notwithstanding the inauguration of new industries, the expansion of existing plants, and intensified research, world chemical production and trade declined in 1938. This was due in large part to large carryovers from 1937, resulting from heavy purchases following the outbreak of hostilities in the Orient.

No significant changes were reported in the international cartels concerning potash, chlorates, dye, sodium sulphate, alkalies, calcium carbide, cyanides, and various fine chemicals, but undoubtedly the territorial changes which took place in Europe will make revisions necessary.